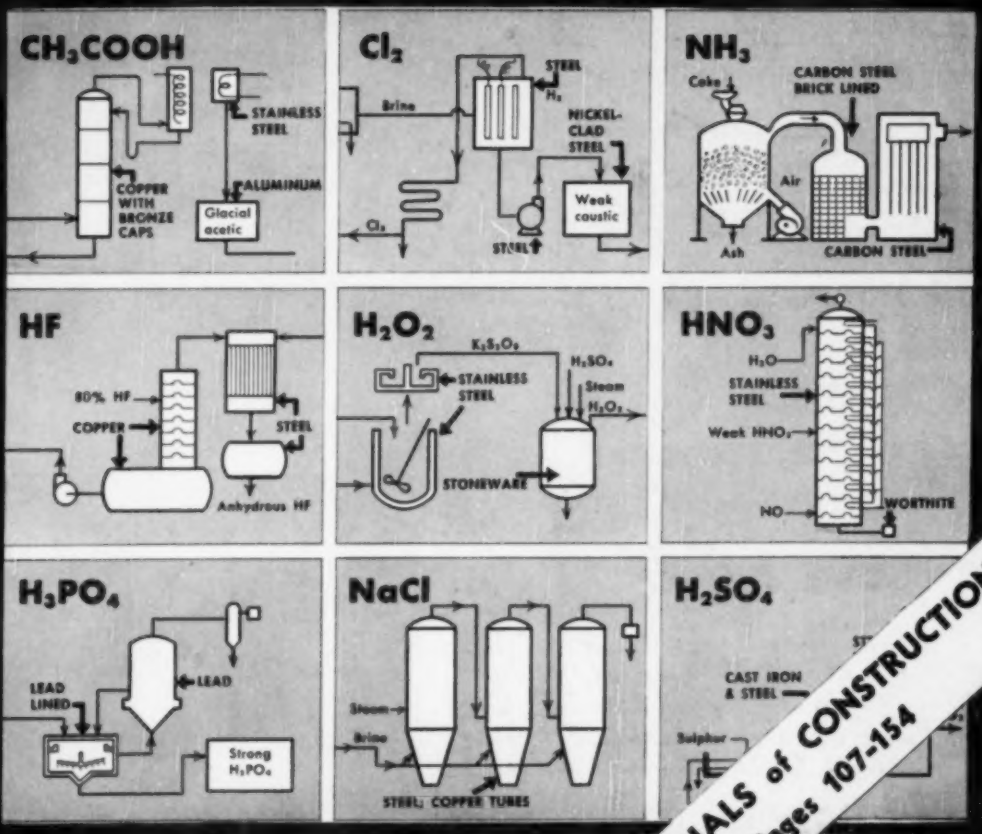
NOVEMBER
1950

Chemical Engineering

WITH CHEMICAL & METALLURGICAL ENGINEERING



COMMERCIAL MATERIALS vs. TONNAGE CHEMICALS — 14th BIENNIAL MATERIALS OF CONSTRUCTION ISSUE P. 107

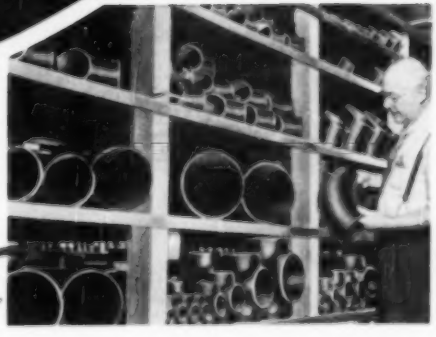
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PACIFIC PROCESS INDUSTRIES **PPI** *A Section of Chemical Engineering*
NOVEMBER 1950 *Vol. 57, No. 11*

PACIFIC EDITION, CHEMICAL ENGINEERING . . . . PACIFIC COAST EDITOR: J. V. Hightower, *San Francisco* . . . . EDITORIAL ASSISTANT: Elizabeth Allen, *San Francisco* . . . . SPECIAL CORRESPONDENTS: James Joseph, *Los Angeles*; Ray Bloomberg, *Seattle* . . . . MANAGING EDITOR: L. B. Pope, *New York*



Nevada Has New Magnesia Plant

Slightly less than a year ago, Standard Magnesia Co., a subsidiary of Standard Slag Co. of Youngstown, Ohio, completed a plant to manufacture a line of magnesia products at Gabbs, Nev., a small mountain locality in the western central part of the state. Today the plant is in normal operation, using as its raw materials magnesite or brucite produced from the company's mining properties. At present the capacity is approximately 50 tons per day of calcined products, and the plant is so built as to permit an easy expansion of capacity.

Individual products being manufactured are pulverized or sized ores, either magnesite or brucite, primarily a low-cost source of magnesia values for various uses; caustic magnesia in a pulverized form from magnesite for use in the production of other chemicals and oxychloride cements; and deadburned magnesia in grain form for use as a refractory in the steel industry.

Lump ore is brought to the plant by truck and passed through a jaw crusher to be reduced to less than three in. size, then processed further in a gyratory crusher and vibratory screen in closed circuit to reduce the product to pebbles smaller than ¾ in. The finally crushed ore is then conveyed from the storage bins to a battery of four rotary calciners, discharged through a grinding mill and mechanically bagged. The finished products are trucked to Luning, Nev., a distance of about 30 mi., for shipment by rail.

Manager at the Gabbs plant is R. O. Jones. Plant superintendent is F. W. Reinmiller, and manager of sales is C. C. Martin. The company's offices as well as the plant are at Gabbs.

Sesamin Being Made Only in West

A little known but potent insecticidal agent, sesamin, is being produced in greater quantities this year because Pacific Vegetable Oil Corp. has put into operation a manufacturing unit that was moved from Mexico City last summer. The company, which is the only commercial producer of sesamin in the world, already had a similar but smaller unit in operation at San Francisco. The unit that was brought from Mexico is now in operation at the company's Richmond, Calif., plant, and has a capacity to handle 5,000 gal. of sesame oil per 24-hr. day.

Sesamin, a substituted dihydrofuran, occurs in sesame oil only to the extent of about 1.5 percent. It is used in pyrethrum insecticides principally as a "synergist," extending the killing power of such insecticides. During the early stages of World War II when the use of sesame oil with these bug killers was introduced, Pacific Vegetable Oil Corp. supplied the government with a number of cars of oil for distribution to insecticide manufacturers. Later McKesson & Robbins, John Powell & Co., and Pacific Vegetable Oil Corp. worked out the processing of sesame oil whereby the active component of the oil, sesamin, could be obtained and the waste of the valuable inert edible oil avoided. Thus sesamin is of value in giving greater effectiveness to pyrethrum, which is in short supply because of lack of imports of the hand-picked flowers.

The sesamin is extracted by means of a solvent which removes the free fatty acid as well as the color bodies. Pacific Vegetable Oil Corp. ships the sesamin concentrate to John Powell & Co., New York, who was exclusive manufacturers and distributors of pyrethrum and sesamin formulations.

Judgment Reached on O'Connor Blast

Judgments totaling $674,301 in damages have been awarded in a Los Angeles superior court as a result of 35 suits brought against O'Connor Electro-Plating Corp. following the disastrous perchloric acid explosion in February 1947, at the O'Connor plant in Los Angeles, when 17 were killed and over 100 injured. The explosion led to the establishment of the city's "Dangerous Chemicals Code" that became effective this year (*PPI*, Mar. 1950).

The long-standing suits, brought by 202 plaintiffs seeking over $3 million, occupied hearings extending from July into September, and were for alleged personal and property losses. The court ordered damages in the amount of $111,896 for personal losses and $562,405 for other losses.

The explosion wiped out the defendant company, whose spokesmen said assets amount to $50,000 in insurance in addition to about $5,000 worth of salvageable material of the wrecked plant.

Pinon Gum Interests Nevadans

Nevada has no naval stores industry, although like some other western states, it does have large tracts of the pinon pine. It remains to be established whether economic factors could support such an industry, but a small tentative start has been made. Nevada Pinyon Products Co. has been organized at Luning, Nev., by Frank E. Sturdevant, president. Sturdevant, who collected gum from the Nevada pinon (singleleaf pine) and sent the material this year to the USDA regional research laboratory at New Orleans

for analysis, says the small new enterprise contemplates building a $50,000 pilot plant next spring near Fallon, Nev.

The particular gum samples examined show an approximate composition of 25 percent (by weight) turpentine, 5 percent cadinene (one of the sesquiterpenes present in the turpentine fraction), and 75 percent rosin. Principal component of the turpentine fraction was alpha-pinene, present to the extent of about 64 percent. The rosin rated a grade of WW.

Cadinene, which is imported from France for cosmetics manufacture, is not present in the turpentine in the South. However, it has been known for some years to be the most frequently encountered sesquiterpene in the pine turpentines. In turpentine from the ponderosa it occurs in the range of 10 percent.

Sturdevant, president of the small Nevada company, says that prior to construction of the pilot plant, field studies will be made to determine the potential yield of gum from the pinon pine, costs of gathering, prices that can be obtained for the gum products, and other economic factors.

N. T. Mirov, California Forest and Range Experiment Station, a USDA branch at the University of California, Berkeley, points out that the reserves of the singleleaf pine in the West are vast. Basic issues as to whether the gum from this tree could be commercially exploited, Dr. Mirov believes, involve such critical points as the extent of the growth within a given region, yield of gum per tree per month, the labor cost involved in gathering the gum. These points would have to be balanced against those of naval stores operations in the South.

U. S. Urges Canadian Action on Gas

The protracted series of hearings that the Petroleum and Natural Gas Conservation Board of Alberta has been conducting for over a year to determine which of several contending companies will get the right to build a natural gas pipeline from Alberta to the Northwest shows signs of coming to an early conclusion and decision. One reason is the aspiration of the new Texas company, Pacific Northwest Pipeline Co., to build a gas line from Texas to the area. Another reason is pressure by the U. S. Munitions Board, which is concerned over the fuel and power situation in the Northwest.

The American agency's concern has been disclosed in the latest round of hearings at Calgary through a letter from Canadian Trade Minister C. D. Howe to N. E. Tanner, Minister of Lands and Mines for Alberta. As quoted, Howe wrote Tanner, "I have recently been advised by the chief of the international program of the United States Munitions Board that the board is seriously concerned about the lack of fuel in the Pacific Northwest of the United States, where wartime industrial developments together with diversion of normal oil supplies to the Far East have seriously accentuated the scarcity. It is suggested that the availability of large supplies of natural gas in Alberta is one source from which the scarcity could be alleviated. I am asked the question whether these supplies could be made available."

Tanner has asked the Alberta board to hasten its deliberations, including a decision as to how much gas can be exported without jeopardizing Alberta's own requirements. The board was scheduled to hold a joint hearing of all applicants on October 30.

Known gas reserves of western Canada, 99 percent of which lie within Alberta, have been estimated at 7 trillion cubic feet, a figure quoted this fall by G. S. Hume, Federal Department of Mines and Technical Surveys in Canada, before a meeting of the American Association of Petroleum Geologists. Hume said that in 19 months the reserves have increased over 2 trillion feet. He added that if a larger market for gas at a fair price could be developed, the known reserves would quickly increase.

Explosives Plant for Calgary

A $3 million plant for the manufacture of explosives will be built on the outskirts of Calgary, Alberta, by Canadian Industries, Ltd. Poole Construction Co., Calgary, has the contract for the project. Plans call for construction of two buildings this year before winter sets in to curtail further work until next April.

Production at the plant is expected to begin late in 1951. Products will be nitric acid, nitroglycerine and various types of dynamite. No information as to capacity has been released. Canadian Industries is manufacturing substantially the same line of explosives in its plant at Brainard, Man., and James Island, B. C.

Dow Plans West Coast Expansion

More caustic soda, chlorine and anhydrous ammonia from the Pittsburg, Calif., plant of Dow Chemical Co. are in the making. Also on the boards is an expansion of the government-owned styrene plant that Dow operates in the Los Angeles area. These facts were learned last month when E. W. Bennett, chairman of the board, and C. A. Campbell, vice president and general counsel, were in San Francisco in consultation with R. L. Curtis, general manager of Dow's Great Western Division.

The company expects to expand the capacity output of caustic soda and chlorine facilities at Pittsburg by between 25 and 30 percent to meet the two-fold purpose of serving growing West Coast requirements and government needs. The program involves a probable expenditure of $1.5 million. Completion: about a year.

An important angle of Dow's caustic-chlorine plans is that the increase in byproduct hydrogen to result from the expansion is expected to get into proportional increase in the manufacture of anhydrous ammonia at Pittsburg. This is the first recent disclosure of plans by a western chemical manufacturer to make more ammonia available for the pulp and paper industry and the fertilizer industry on the Pacific Coast. Several ammonia manufacturers are in the competition.

Dow's operations in the West have been up against the increasing difficulty of obtaining rail transportation for raw materials and finished products. About two months ago the company started using trucks to transport salt from San Francisco peninsula producers to Pittsburg, and is now moving about 40 percent of its salt in that manner. Dow's Great Western owns a fleet of trucks to move some of its chemicals and rents trucks for other services.

The company says that the government is planning to expand the capacity of the government-owned styrene plant

CHEMICAL ENGINEERING (with Chemical & Metallurgical Engineering) is published monthly. Price 50 cents per copy. PUBLICATION OFFICE 99-129 North Broadway, Albany 1, N. Y. Entered as second-class matter at the Post Office at Albany, N. Y., under the act of March 3, 1879. Subscription rates: United States and Possessions, $3 per year, $4 for two years; $5 for three years; Canada, $4 per year, $6 for two years, $8 for three years (payable in Canadian funds); Pan American countries, $10 for one year, $16 for two years, $20 for three years; all other countries, $15 a year, $20 for three years. Return postage guaranteed. McGRAW-HILL PUBLISHING CO., Inc., James H. McGraw (1860-1948), Founder. EDITORIAL AND EXECUTIVE OFFICES: 330 West 42nd St., New York 18, N. Y. CURTIS W. McGRAW, President; WILLARD CHEVALIER, Executive Vice President; JOSEPH A. GERARDI, Treasurer; JOHN J. COOKE, Secretary; PAUL MONTGOMERY, Senior Vice President, Publications Division; RALPH B. SMITH, Editorial Director; NELSON BOND, Vice President and Director of Advertising; J. E. BLACKBURN, Jr., Vice President and Director of Circulation. CABLE ADDRESS "McGraw-Hill, N. Y." Member A.B.P. Member A.B.C.
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that Dow operates near Los Angeles from the present level of 7.2 million pounds per month to a new capacity of 9.0 million. It is believed that the expansion will become effective by the end of the year. The increase is slated to go into the production of synthetic general-purpose rubber.

The company is well aware of the needs of extraordinary plant protection on the Pacific Coast and elsewhere if another "emergency" occurs. A short time ago the company invited plant officials and government representatives to Midland for a three-day discussion. As a result, the outlines of what government men described as a "model" plan were disclosed. The plan will be applied on a scale commensurate with future requirements.

Chemonite Rights Sold

J. H. Baxter & Co., San Francisco, a wood preserving company operating several plants on the Pacific Coast, has acquired from Dr. Aaron Gordon the rights to use the Chemonite treating process and to sublicense its use in states west of the Mississippi river. This is the first such licensing of the process, although it has been used by Diamond Match Co. at Stirling City, Calif., for 15 yr.; West Oregon Lumber Co. at Portland for 10 yr.; and National Wood Treating Co. at Oroville, Calif., for 3 yr.

Baxter plans to install equipment to use the process in its creosoting plants at Alameda, Calif., and Eugene, Ore. Last month the company's subsidiary, Baxco Corp., leased Union Pacific Railroad Co.'s creosoting plant at The Dalles, Ore., formerly operated by Forest Products Treating Co.

The Chemonite process was developed during 1924 and 1926 by Gordon and associates while Gordon was associated with the University of California. Nine years after Douglas fir and white fir had been experimentally treated on the property of Diamond Match Co., inspection of the wood led the company to install the first commercial equipment to employ the process. The active ingredients are cupric hydroxide and arsenic trioxide. An ammoniacal solution is applied under pressure to the wood in cylinders similar to those used in creosoting.

Canadian Aluminum Survey Proceeds

The long-term $500 million project in British Columbia for which Aluminum Co. of Canada began the preliminary investigations in 1948 seemed nearer to realization last month when company engineers decided that a suitable damsite for the contemplated hydroelectric installation had been established. The site, established after a year of engineering studies covering other locations that proved unsatisfactory, is a point in the Nechako river canyon in the Tweedsmuir park region of northern British Columbia. It has been concluded that conditions at the site are suitable for the construction of a 300-ft. high dam.

The dam would halt the present eastward movement of water in the river, which drains Tetachuck, Whitchall, Ootsa, Tahtsa and other lakes in the great watershed region, with the result that the water would be diverted westward 150 mi. to Tahtsa lake. From this lake it is contemplated that the water would be moved farther westward through a 10-mi. mountain tunnel to the proposed powerhouse on the Kemano river. The scheme is designed to develop 1.5 million hp. Further survey work is being performed by B. C. Engineering Co.

In addition to the major dam, another damsite is being tested at a point on Nanika river. A dam built there would divert water from Nanika lake southward through a tunnel to Tahtsa lake in order to furnish sufficient power for the initial phase of development.

A major problem remaining still is the selection of a route for a transmission line to carry power from the Kemano river powerhouse northwest to Kitimat at the head of Douglas channel on the eastern coast, where the projected aluminum reduction plant would be built. Kitimat is the nearest area where sufficient suitable land for a plant and townsite is available. Possible alternative routes are either a 48-mi. overland route traversing the mountains or a longer circuit following the Gardner canal. Weather conditions will be tested by a crew this winter. Two short test spans of transmission line were scheduled to be installed last month to check ice loading.



Boeing Controls Chemical Wastes

Like other aircraft manufacturers, Boeing Airplane Co. at Seattle consumes a considerable volume of chemicals, principally for cleaning, plating and heat treating, and has had a chemical waste disposal problem to solve. The company's problem required attention because the plant is near the Duwamish river, which empties into Puget sound. Within the last year a disposal system has been installed that meets the approval of the state pollution control commission. The system cost only about $15,000.

Boeing segregates its wastes and disposes of them separately. Caustic and acid solutions are discharged into 1,000-gal. underground cisterns constructed of porous brick laid without mortar in their vertical interstices. The solutions are gradually dissipated into the earth and lose their toxicity before reaching the river. Acids and alkalis are discharged into separate cisterns to avoid possible precipitation of salts that would seal the cisterns and adjacent soil.

Cyanide wastes are handled differently. The materials are converted by oxidizing agents to the less toxic cyanates, which are then piped to an outflow at the river, where the material is first highly diluted with 1,400 gpm. of river water and finally released into the river. The discharge is continuously analyzed to guard against the presence of cyanides.

New Firm Buys Canadian Industries

A new company, Green Valley Fertilizer & Chemical Co., Ltd., has bought the British Columbia fertilizer business and manufacturing plant of Canadian Industries, Ltd., at New Westminster. Green Valley expects to continue all operations of the plant and to serve existing British Columbian markets, although products will be distributed under the Green Valley trademark. The products include superphosphate and mixed fertilizers.

The new firm plans in addition to handling fertilizers to go into the general field of agricultural chemicals, with

emphasis on pesticides developed in the laboratories of Canadian Industries. The present staff of manufacturing and sales forces will be retained.

Heading the new firm is Francis V. Lumb, a banker. The board of directors includes Air Vice Marshal Leigh Stevenson, a member of the British Columbia legislative assembly; and F. H. Brown, financial adviser to C. D. Howe during World War II.

The Coke Ovens at Ironton

Last month Kaiser-Frazer Corp. was discussing plans for reactivating its blast furnace and coke ovens in the vicinity of Ironton, Utah. During World War II the government-owned installation was operated by Geneva Steel Corp., subsidiary of U. S. Steel Co. Involved in the property were 500 bee hive coke ovens with a total capacity of around 1,000 tons of coke per day. After the war, Kaiser interests bought the installation from the government, and it was operated for a time by Kaiser Steel Corp. for Kaiser-Frazer, but was shut down early in 1949.

A few weeks ago Kaiser-Frazer was investigating the steel situation on the Pacific Coast with a view to the possible reopening of the blast furnace and coke ovens on an expanded scale that would involve construction of new equipment. Under consideration were such new facilities as modern byproduct coke ovens and steel making equipment.

Coatings Firm Considers Los Angeles

A 12-acre plant site in the Anaheim section of Los Angeles has been purchased by Neville Co., Pittsburgh, Pa., manufacturer of resins and paint components. The company plans to construct on the site a manufacturing plant, office and tank farm. A Neville official said last month that the projected Anaheim plant will probably manufacture the company's full line of petroleum-based resins, coumarone-indene resins, solvents and aluminum paint vehicles.

Although a definite appropriation for the project had not been made last month, the company is making engineering studies as the preliminary step for construction. The company at present has a temporary West Coast office at the plant of U. B. Bray Co., a Los Angeles firm which has been associated with the company for several years.

NAMES IN THE WEST



R. J. Blackinton

R. J. Blackinton has been appointed resin application engineer of the West Coast Chemicals division of General Electric Co., and will be stationed at Anaheim, Calif. He is a chemistry graduate from California Institute of Technology in 1940. Before joining General Electric's chemical division at Anaheim he was technical director of Western States Lacquer Corp. at Los Angeles. He is a past president of the Los Angeles Paint and Varnish Production Club.

James T. Foster has become manager of the Central division of Richfield Oil Corp., and is stationed in San Francisco. He replaces H. T. Hutchinson ,who has become assistant general sales manager of Richfield at the company's Los Angeles headquarters.



E. E. Boudinot

E. E. Boudinot, who has been with General Petroleum Corp. at Los Angeles since 1917, will supervise construction of the $30 million refinery (crude capacity, 20,000 bbl. per day) to be built at Corvton, England by Vacuum Oil Co. Both General Petroleum and Vacuum Oil are affiliates of Socony-Vacuum Oil Co. Boudinot, now in England, played an important part in early construction and growth of General's refinery at Torrance, Calif. The English project he will supervise will take about 30 months to complete.

Nils G. Teren, formerly vice president, has become president of Oregon Pulp & Paper Co. **Robert H. Noyes,** former president, has retired.

John H. Baker is named general superintendent of manufacturing operations of Pennsylvania Salt Mfg. Co. of Washington, and will supervise the company's plants at Tacoma and Portland, as well as Bryan, Tex. He has been superintendent of the Tacoma plant since 1928, at which time Pennsalt incorporated Tacoma Electrochemical Co. His prior experience includes service with Michigan Electrochemical Co.'s plant at Menominee, Mich., where he became superintendent before being transferred to Tacoma after Pennsalt acquired the Michigan firm in 1924.

E. M. Gray has become manager of the Southern California division of General Petroleum Corp. **L. E. Bourquin** succeeds him as manager of the Northern California division, having formerly been Gray's assistant. **F. C. Black** becomes assistant manager of the northern division.

Gail Shaw, who was in charge of pilot plant work for Eli Lilly & Co., Indianapolis, for seven years, has joined I. P. Callison & Sons, Chahalis, Wash., as technical director. Shaw is a graduate from the chemistry department of American University and a chemical engineering graduate of Iowa State University. He was with National Aniline division of Allied Chemical at Buffalo before joining Lilly.

Harry A. Thurlow, resident engineer since 1945 for Rayonier, Inc., at Port Angeles, Wash., has become assistant resident manager. **Bryan L. Rauschert** has been promoted from assistant to resident engineer, and **Donald E. Lawson,** previously shift superintendent, is the new assistant resident engineer. Thurlow is an engineering graduate of the University of Washington, and joined Rayonier at Hoquiam, Wash., in 1934.



T. J. Ready



D. E. Browne



S. S. Inch

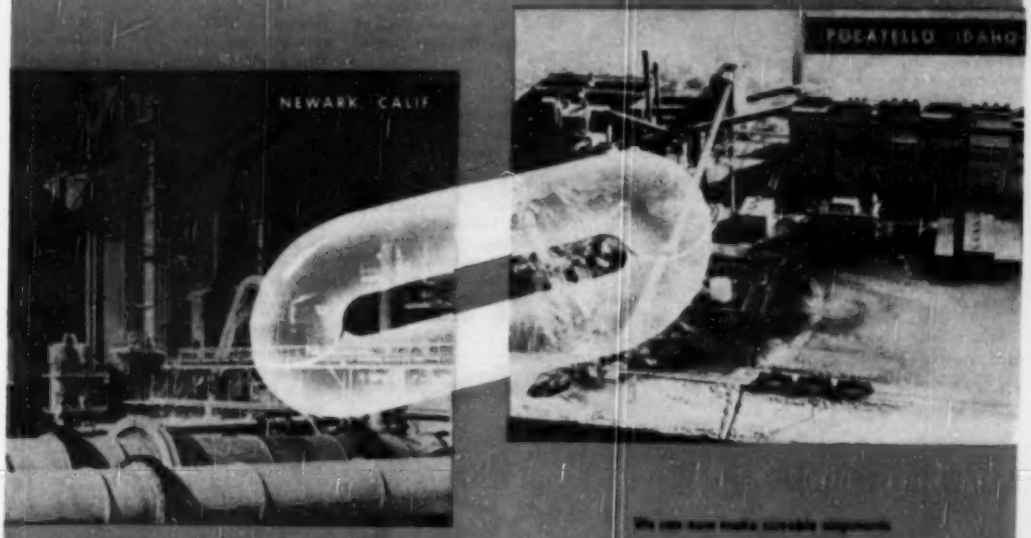
S. S. Inch has become vice president of sales for Kaiser Aluminum & Chemical Sales, Inc. **Thomas J. Ready, Jr.,** is a new vice president. **Donald E. Browne,** who was formerly controller for the company, has become a vice president and treasurer. Inch has been general sales manager of the company. Ready has been assistant general manager of Kaiser Aluminum & Chemical Corp. Russell A. Clayton has been named controller of Kaiser Aluminum & Chemical Corp. All officials have been connected with Kaiser Aluminum in administrative positions since the company entered the industry.

Alvin E. May has become assistant to Dr. R. W. Truesdail, president of Truesdail

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Laboratories, Los Angeles, in the dual capacity of process engineer and technical sales representative. A graduate from the chemistry department of Fresno State College, he joined American Potash and Chemical Corp at Trona, Calif., but left Trona in 1947 to become a process engineer with Sharples Corp. at Philadelphia.

T. S. Hodgins, manager of the Pacific Northwest Division of Reichhold Chemicals, Inc., at Seattle, has been elected a vice president of the company.



G. W. Newell

Gordon Newell has joined Stanford Research Institute, Stanford, Calif., as senior biochemist. He was previously biochemist for two years with Wallace & Tiernan Co., Newark, N. J. Dr. Newell is a graduate of the University of Wisconsin and is a member of American Chemical Society, American Association for the Advancement of Science, New York Academy of Science and several other groups.

Robert Edwards, assistant manager of the Ocean Falls, B. C., paper mill of Pacific Mills, Ltd., is expected to become manager of the newsprint mill that Elk Falls Co. will build at Duncan Bay, Vancouver Island, B. C. **Howard A. Simons** has been selected as consulting engineer in the design and construction of the Duncan Bay mill.

James A. Williams, previously vice president of Bonesteel & Co., San Francisco, has been named sales manager of the pulp and paper division of Potlatch Forests, Inc., Lewiston, Ida. Potlatch expects to have its new kraft mill completed early next year.

Charles W. Tobias and **F. Campbell Williams,** who have been instructors in chemical engineering, college of chemistry, at the University of California at Berkeley, have become assistant professors. Tobias received his doctorate from the University of Technical Sciences at Budapest, Hungary, and is a specialist in electrochemistry. He came to Berkeley about three years ago. Williams, who is a Ph.D. from the University of Iowa, has devoted much of his time to vapor-liquid equilibria investigations.

G. H. Kissin, formerly a member of Physical Science Associates, Berkeley, Calif., has joined Kaiser Aluminum and Chemical Corp. at Spokane to handle metallurgical research.

Henry Eyring, professor of chemistry and graduate school dean, University of Utah, is winner of the Nichols Medal for 1951, the award presented annually by the New York section of American Chemical Society. The recognition, to be presented next March, cites his contributions in theoretical chemistry.



T. E. Moffitt

Thomas E. Moffitt is new Assistant Works Manager of the Tacoma plant of Hooker Electrochemical Co. He is a chemical engineering graduate of Cornell University, a naval flyer in World War I, and was active in engineering work in Spokane and Seattle during 1920-1930 prior to joining Hooker Electrochemical. Works Manager at the Tacoma plant continues to be John D. Rue, and Albert H. Hooker is Western Sales Manager.

OBITUARIES

Edward M. Mills, 75, who was one of the founders and until 1943 president and director of Rayonier, Inc., died in San Francisco on October 10. Until recently he had been a director of Crown Zellerbach Corp. In 1919 he came to Seattle and joined Zellerbach interests in setting up Washington Pulp and Paper Co. Later he organized four other companies, which in 1937 were merged as Rayonier, Inc., with Mills as president.

M. F. Coolbaugh, 73, president emeritus of Colorado School of Mines, has died at Golden, Colo. He was a long-time member of American Chemical Society.

Charles V. Averill, mining engineer for the California State division of mines at San Francisco for over 20 years, is dead following a short illness. He joined the state's mining engineering staff in 1928. He had been stationed in San Francisco since 1947, and was an authority on the minerals of California.

FIRMS IN THE WEST

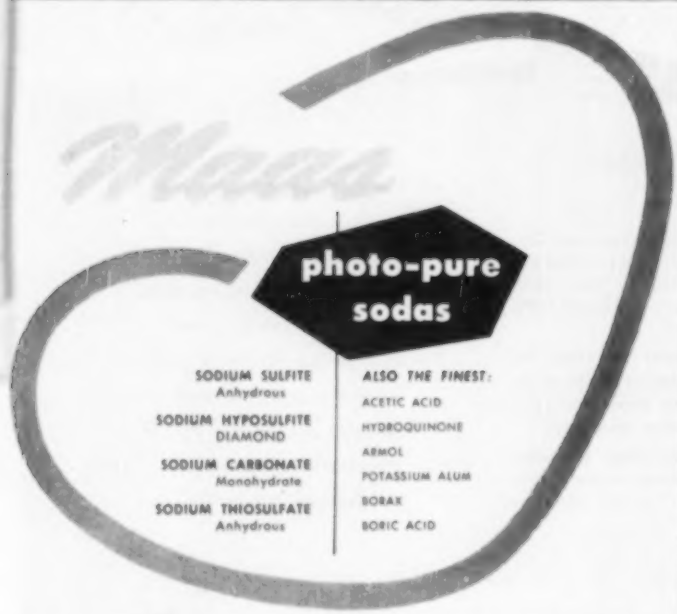
International Minerals & Chemical Corp., is installing at its monosodium glutamate plant at San Jose, Calif., an additional stainless steel evaporator and another raw materials storage tank, the total expansion being estimated at about $130,000. A new $22,000 warehouse addition has been completed.

Riverside Cement Co., Oro Grande, Calif., expected last month to complete its $1 million raw grinding expansion by October 21. It is estimated that the expansion will raise the plant's capacity to 3.2 million bbl. of cement per year.

Allied Dye & Chemical Corp., New York, will build a manufacturing plant at Kennewick, Wash., to supply chemicals required by the nearby Hanford Works of Atomic Energy Commission. Construction was scheduled to begin in November.

We're Moving

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Division of Victor Chemical Works
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The plant is expected to employ about 25.

Caram Manufacturing Co., Los Angeles, is building a $75,000 plant at Monrovia, a Los Angeles suburb. The 12,000 sq. ft. structure will enable the company to increase its output of rubber adhesives and cement by about 20 percent. The company plans to move from its present plant at Los Angeles early next year.

Pabco Products, Inc., is the new name of the Paraffine Co., Inc., manufacturer of roofing, flooring, wallboard and protective coatings at Berkeley, Calif. Stockholders have voted the change of names because the trade name "Pabco" has been used for about 20 years to identify company products. When the company was founded many years ago by Pierce and Beardsley, the first products were known as P. & B. paints and roofings.

Fibreboard Products Inc. has promoted E. E. Olfson from his former position of office manager of the Stockton, Calif., division to his new position of assistant resident manager of the Antioch division, Antioch, Calif. The company has also named P. C. Nash office manager at Stockton; he was formerly in the accounting department in San Francisco.

Puget Sound Pulp & Timber Co. plans a $120,000 addition to the bleaching plant in its mill at Bellingham, Wash. The company has previously spent about $1.2 million on the bleach plant.

Merle Norman Cosmetics, Inc., has bought a five-acre tract at Los Angeles for the purpose of erecting a $1 million manufacturing plant, office and warehouse. Construction expected to begin within three or four months.

Weyerhaeuser Timber Co. will enlarge its kraft pulp mill at Longview, Wash., to increase the output by about 175 percent of the present capacity of 220 tons per day. Installation of the new equipment will probably begin next summer, with completion scheduled for 1952.

Fibreboard Products Inc. plans a large expansion on 11 acres of land adjoining the present mill at Sumner, Wash., and also expects next spring to undertake a $250,000 modernization program at Port Angeles, Wash. The project at Sumner is part of a program begun in 1946. Capacity at Port Angeles will be materially increased as a result of the construction to be undertaken there.

Allied Synthetics Co., manufacturer of a synthetic resin-impregnated glass for skylights and partitions at San Diego, Calif., has changed its name to Alsynite Co. of America following a change of ownership in which Louis L. Potomac has become president and John S. Berkson executive vice president. Alsynite is the trade name of the company's product.

Versatile Chemicals, Inc., is the new name of Hexagon Laboratories, Glendale, Calif. The company manufactures a line of organic sulphur compounds including sul-

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Everett Pulp & Paper Co. plans to install a new paper machine at Everett, Wash., to increase plant capacity by 50,000 tons of paper per year. A new building will be erected to house new digesters, evaporators and other equipment costing several million. The plant will increase its personnel from the present 150 workers to 200.

Pacific Coast Paper Mills has completed an $800,000 expansion to increase capacity of the plant at Bellingham, Wash., and employment has increased from 150 to 190.

Western Chemical & Manufacturing Co., Los Angeles, producer of industrial cleaning agents, has completed a $200,000 office building and warehouse at Phoenix, Ariz. The company has previously been using rented property at Phoenix, from which the products manufactured at Los Angeles have been distributed in Arizona. The company makes a line of acids, alkalis, soaps and gases. Eldon Mitchell is in charge of the Phoenix operation.

Longview Fibre Co. has completed a new $250,000 wood preparation section in its plant at Longview, Wash., in order to utilize logs of 8-ft. length to be used in the operation of a new paper machine being installed at the plant.

Hobbs Battery Co., manufacturer of automotive batteries at San Francisco, plans to move its plant and administrative offices to Oakland early next year. The company has bought a 60,000 sq. ft. site at Oakland and expects to install facilities capable of turning out 1,000 batteries daily. The San Francisco output has been approximately 700. The company has other plants at Los Angeles and Portland.

WESTERN LITERATURE

Chemical Utilization of Subbituminous Coals of Washington. Report No. 6. An 83-p. report by L. A. Conradi, research assistant in the Engineering Experiment Station of University of Washington, issued in October. The study summarizes the lines of research and pilot plant operations designed to upgrade Washington coals into fuels of higher grade and chemical commodities. Chapters headings: Subbituminous Coals of Washington, Combustion, Coal Extraction, Coal Gasification, Low-Temperature Carbonization, Hydrogenation of Coal and Tar. Considerable space is devoted to low-temperature carbonization, a number of processes being described. Included in the report is a long list of references and a supplemental bibliography. A good bird's-eye view of what has been done in the field. Available from the engineering experiment station, University of Washington, Seattle.

Mineral Commodities of California—Bulletin 156. A just-issued, comprehensive, 443-page review of the entire mineral industry of California covering occurrences and statistical information concerning about 100 minerals. The work is a product of the entire technical staff of the state's division of mines in cooperation with the U. S. Bureau of Mines. Included in the compilation is a map showing the general distribution of the minerals and the geomorphic provinces of the state. Designed to aid the explorer, producer and consumer of mineral materials. Available at $2 from Department of Natural Resources, Division of Mines, Ferry Building, San Francisco.

Glazes From Oregon Volcanic Glass. A short paper issued in August on the subject of the use of volcanic glass as a substitute for feldspar in the manufacture of glazes suitable for stoneware, art ware and terra-cotta products. The glazes were perfected after about two years of research by C. W. F. Jacobs, ceramist with the Oregon State Department of Geology and Mineral Industries. The paper includes results and test data. Available at 20 cents from the above-named state agency, 702 Woodlark Bldg., Portland, Ore.



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✳ **NOTE:**
The Advertiser's Index, formerly a part of Reader Service, is now separate and precedes this section.

Memo from the Editor

Specific Questions, Specific Answers

One day last spring Les Pope, Ed Fetter (now with du Pont) and I were trying to figure out what approach to take on this year's materials of construction report. Then a letter from Cincinnati came in:

"I need to handle semi-liquid fatty acids in a reactor at 170 deg. F. and under 30 psi. I can't afford to have my product contaminated. What construction material should I use for the reactor—and who makes it?"

That engineer had a definite problem. He wanted a definite answer—and he wanted it fast, with no fooling around. That inquiry gave us just the clue we were looking for.

For several months we talked to engineers who specify the materials of construction used in their plant equipment; we talked to others who make or sell these materials to the chemical process industries. "What kind of a report would be most useful?" Everywhere we got advice that boiled down to this: "Make it practical; make it specific; make it easy to use."

That's exactly what we've tried to do in this month's report (pp. 107-154). It is, by the way, our 14th biennial report on materials of construction for chemical process equipment. (Jim Lee, our Southwest Editor, put out our first one back in 1923).

This year we're doing something new: for the next six months or more we will continue the report in our Corrosion Forum department. In this way we can give you more data for more chemicals—and keep it up-to-date, too. So if you'll add each month's Corrosion Forum pages (price of reprints available upon request) to this month's feature report, you'll soon have what amounts to a good-size book that will cover some 15 materials of construction for over 20 corrosive types of chemicals.

Wanna Write?

Your editors are wondering about a deluge of articles that seems to be in the offing. Apparently lots of people are right on the verge of sitting down at their typewriters and dashing off some mighty important stuff for us to print for you.

This delightful hallucination has been brought about, not by exposure to fumes of choral (see p. 204), but by a series of letters we have been receiving. They all say practically the same thing. "Send me a copy of your 'Notice to Authors.' If you don't have one, what kinds of articles do you want and how should they be submitted?"

We have to tell these nice prospective authors that we don't have any "Notice." Then we tell them approximately what kinds of things we think you want to read.

Are you a prospective author too? If you are, here's a reminder. It's the sort of reply we have been making to those letters I mentioned.

NOTICE TO AUTHORS

Chemical Engineering is written and edited for chemical engineers. Our aim is twofold: to inform and to instruct. We are trying to help you do your job better, easier, faster. We are trying to keep you up-to-date on what's happening.

Our plant description articles tell you about new plants and new processes and how they work. The common denominators of unit processes and unit operations serve to make plastics plants interesting and instructive to soapmakers, for example.

Our engineering articles give you dope on chemicals, operations, equipment. You can easily figure out how it helps you. This type of article sometimes gives fundamental data not readily available elsewhere. Or how to get rid of wastes, or how to figure costs. Or something else of permanent value.

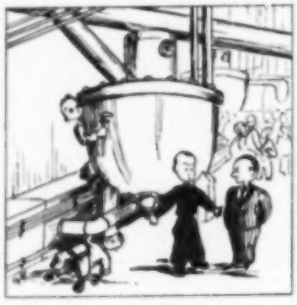
Other articles—all with the same aim—bring you information on a variety of subjects: mathematics, economics, statistics, foreign engineering.

Do you want to write an article for us? Go ahead. We have absolutely no "must" requirements. You may send us an article written in Arabic with a blunt pencil on a piece of old wrapping paper. Chances for its acceptance and publication, however, would be enhanced if it were typewritten double space on standard size (8½x11) white paper. Keep in mind our aim. Inform and instruct.

Remember this when you are writing for us; simple, clear, readable English—that's the ticket. Include charts, graphs, drawing and photographs whenever possible. They help to get a story across easily and quickly.

Don't worry about style, or summaries, or abstracts, or lots and lots of footnotes. Just remember, if you have something to tell, tell us. Keep it clear and simple. We will pass it along to the rest of the chemical engineers in the country.

LITTLE BONERS



It Disappeared

The new plant was a whopping big one and a beauty of an engineering job. The service lines were a maze that had been worked out with geometric precision. One of the lines served filtered water from a storage tank to the main reaction vessels.

Then the time came to start up the unit. It was a big day. Top brass and engineers were all there. But the operator couldn't find that water line to the reactors. The blueprint showed it should be there but it just wasn't. Yes, the water storage tank was where it should be, and a line from it started off in the direction of the main process building. But where on earth did it go to?

After several hours of humiliating detective work on the service line maze, that water line was found—neatly fitted to the hand rail of a fire escape*.

* Yes, it actually happened at one of the biggest plants of one of our proudest chemical companies. Watch for other "Little Boners" to come.

NOVEMBER 1950

VOL. NO. 11

Chemical Engineering

WITH CHEMICAL & METALLURGICAL ENGINEERING

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Chemical Engineering (with Chemical and Metallurgical Engineering) is published monthly by McGraw-Hill Publishing Co., Inc. Copyright 1950 (all rights reserved). Entered as second-class matter Sept. 3, 1936, at Post Office at Albany, N. Y., under act of March 3, 1879. Return postage guaranteed.

Subscription Information—Published monthly. Price 50 cents per copy. (Price of this issue one dollar per copy.) • Subscription rates: United States and possessions, $3 per year, $4 for two years, $5 for three years; Canada, $4 per year, $6 for two years, $8 for three years (payable in Canadian Funds); Pan American countries, $10 per year, $15 for two years, $20 for three years; all other countries, $15 per year, $30 for three years.
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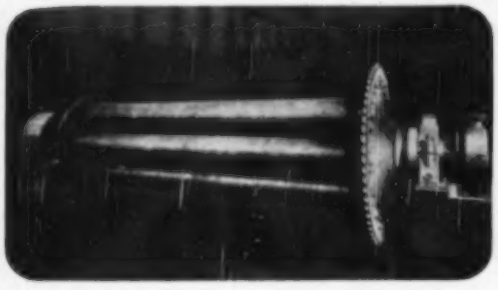
Company Offices—Publication Office: 99-129 North Broadway, Albany 1, N. Y. • Editorial and Executive Offices: 330 West 42nd St., New York 18, N. Y. • Branch Offices: 520 North Michigan Ave., Chicago 11; 68 Post St., San Francisco 4; Aldwych House, Aldwych, London W. C. 2; National Press Bldg., Washington 4; Philadelphia 3; Cleveland 15; Detroit 26; St. Louis 8; Boston 16; Los Angeles 17; Atlanta 3; Pittsburgh 22; Houston 2.



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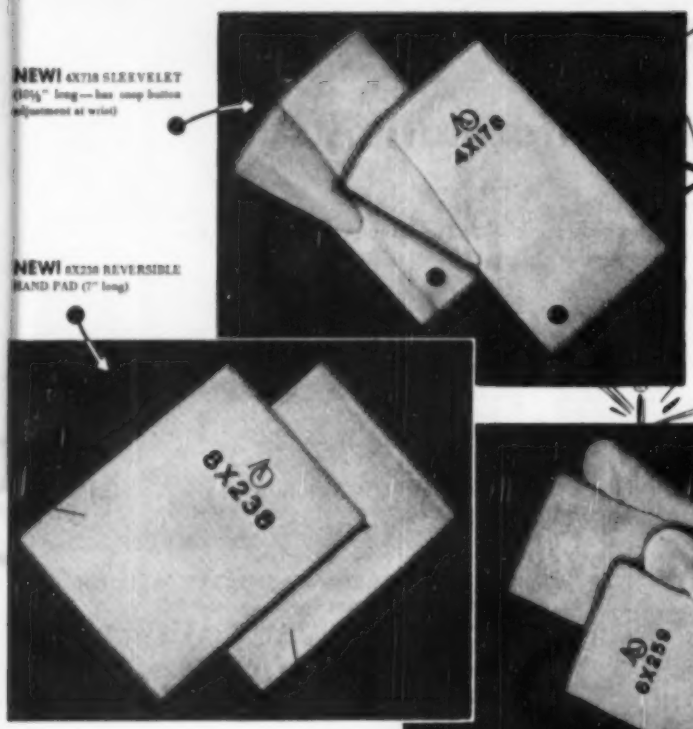
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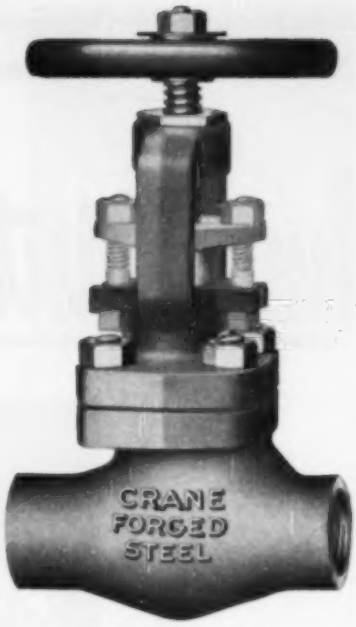


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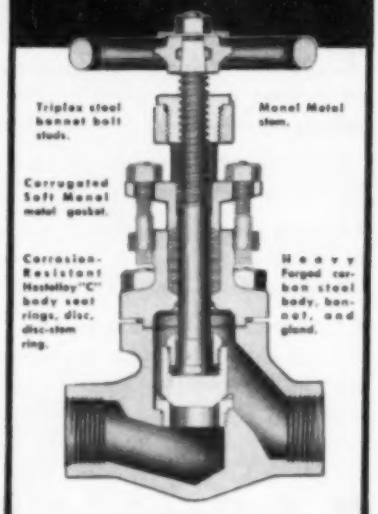
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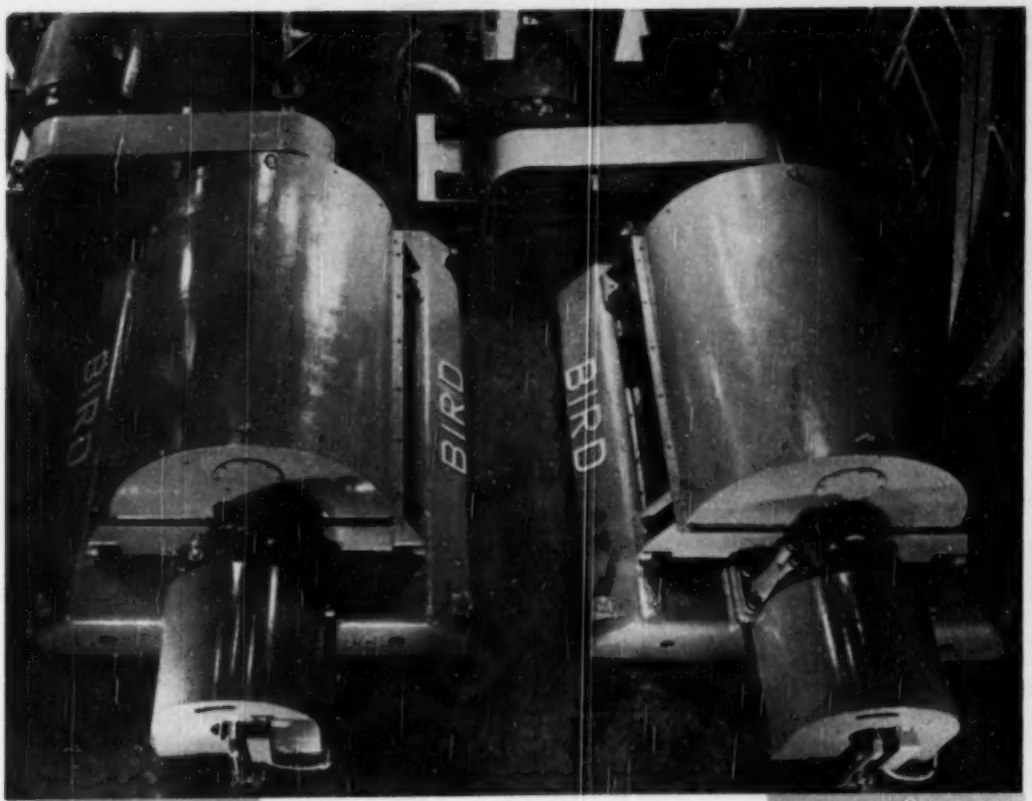


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Many Chemical Products are efficiently handled by BULK-FLO CONVEYORS *because . . .*

- It is self-loading to capacity, requiring no separate feeder.
- It simplifies the layout — one Bulk-Flo often serving where several other types of conveyors would be required.
- It is very compact, occupying minimum space.
- It operates slowly, moving the material in compartments, without churning action, thus assuring gentle handling of material with minimum power consumption.
- Most material can be conveyed whether the compartments are fully or partially loaded.
- It assures dust-tight operation, and minimizes degradation of material.
- If a vertical unit is operated for several minutes at the conclusion of a run, no appreciable amount of material will remain in the carrying run of casing.
- It permits the use of multiple feed and discharge points along horizontal runs of conveyor.
- Each conveyor flight substantially fills the area of conveyor casing, therefore prevents backward avalanching of materials on vertical runs.
- It is extremely flexible in its field of application, because of the various paths of travel possible and the ability of one Bulk-Flo to convey both horizontally and vertically or on an incline.
- Bulk-Flo equipment frequently costs less than that of other types of conveying and elevating apparatus required to accomplish the same function or purpose.

- **A Link-Belt engineer will be pleased to discuss your problems without obligation.**

LINK-BELT COMPANY

Chicago 8, Indianapolis 6, Philadelphia 40, Atlanta, Houston 1, Minneapolis 5, San Francisco 24, Los Angeles 33, Seattle 4, Toronto 8. Offices in Principal Cities.

11,700-C

LINK-BELT

BULK-FLO
Elevator-Conveyor-Feeder



Separated-run design, L-path arrangement Bulk-Flo with side-discharge or front-discharge head section for multiple feed points and where feed control and accessibility are essential.

DIRECT CURRENT



USERS—

BUFFALO ELECTRO-CHEMICAL ORDERS THIRD AND FOURTH I-T-E MECHANICAL RECTIFIERS

Here in a nutshell is the power conversion news of the year! After pioneering the first mechanical rectifier installation in the U.S.A., the management of Buffalo Electro-Chemical Company, Inc., Buffalo, N.Y., again has chosen the I-T-E Mechanical Rectifier to furnish power for a modernization program.

Deciding factors in Buffalo's decision were the mechanical rectifier's high inherent efficiency, small space requirement, low maintenance cost, and ease of operation.

The two original rectifier units, both rated at 3500 amperes, 260 volts d-c, have given 96.6% efficiency in their installation [illegible]

HERE'S NEWS FOR *You!*

MORE INDUSTRIAL ORDERS FOR MECHANICAL RECTIFIERS

Further power conversion news has been made by the following companies, who have placed orders for their first I-T-E Mechanical Rectifiers.

General Motors Corp.
Janesville, Wisc.

•

Hercules Powder Co.
Hopewell, Va.

•

Superior Gas & Equipment Co.
Philippine Islands

•

U. S. Metals Refining Co.
Cartaret, N. J.

•

Marathon Paper Mills of Canada, Ltd.
Marathon, Ontario, Canada

•

Imperial Chemical Industries, Ltd.
Cheshire, Runcorn, England

•

Pennsylvania Salt Mfg. Co.
Wyandotte, Mich.

•

Fields Point Manufacturing Corp.
Providence, R. I.

These companies join the growing list of users of the [illegible] mechanical rectifier. The many adv[illegible]

I-T-E

MECHANICAL [illegible]

SINCLAIR'S

Improved Pennsylvania Motor Oil Plus

and other famous motor oils are

100% TRI-SURE PROTECTED



SINCLAIR—a name renowned for quality—is announcing an improved Sinclair Pennsylvania Motor Oil, which attains a new high in performance and quality.

To protect that quality—to preserve the purity and performance of every gallon of Pennsylvania Motor Oil Plus—Sinclair drums are equipped with Tri-Sure Closures*.

Since 1936, the Sinclair Refining Co. has standardized on Tri-Sure protection for all of its lubricating oils in drums—because its experience has confirmed its selection of Tri-Sure Closures as the *dependable* safeguard against leakage, seepage, pilferage and substitution.

Companies which insist that their packaging be worthy of their product make it standard policy to specify "Tri-Sure Closures". On *your* next drum order, take this simple, certain, proven way to provide the security that all fine petroleum and chemical products deserve.

Tri-Sure
Reg. U. S. Pat. Off.

CLOSURES

*The "Tri-Sure" Trademark is a mark of reliability backed by 28 years serving industry. It tells your customers that genuine Tri-Sure Flanges (inserted with genuine Tri-Sure dies), Plugs and Seals have been used.

AMERICAN FLANGE & MANUFACTURING CO. INC., 30 ROCKEFELLER PLAZA, NEW YORK 20, N. Y.
TRI-SURE PRODUCTS LIMITED, ST. CATHARINES, ONTARIO, CANADA

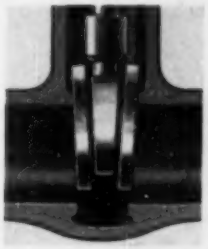
ALOYCO sets the STANDARD



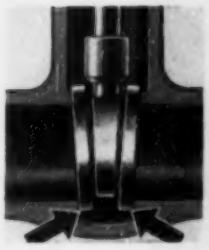
ALOYCO GATE VALVE, No. 111, 150 lb., Flanged, F and D. Sizes ½" to 12".



These 3 sturdy parts comprise the Aloyco Double-Disc Ball-and-Socket Wedge.



The floating discs are free to rotate and thus wear evenly.



Wedge ring forces discs against seat, sealing ports with double valve effect. If one disc should leak, the other would still maintain closure.

When you install Aloyco Corrosion-Resistant Valves, their exceptionally long "life expectancy" makes substantial savings in your operating costs.

Aloyco durability is due to the painstaking development of the best practice in every step of the manufacture of these valves—from the drafting room clear through to the test bench. Even after years of service they operate freely and positively without external aids in the most severe applications.

Take the No. 111 Gate Valve, for example. This valve with its remarkable split wedge construction has been imitated widely, but never equalled outside of the Aloyco shops. Its excellent workmanship in every detail is typical of all Aloyco Valves.

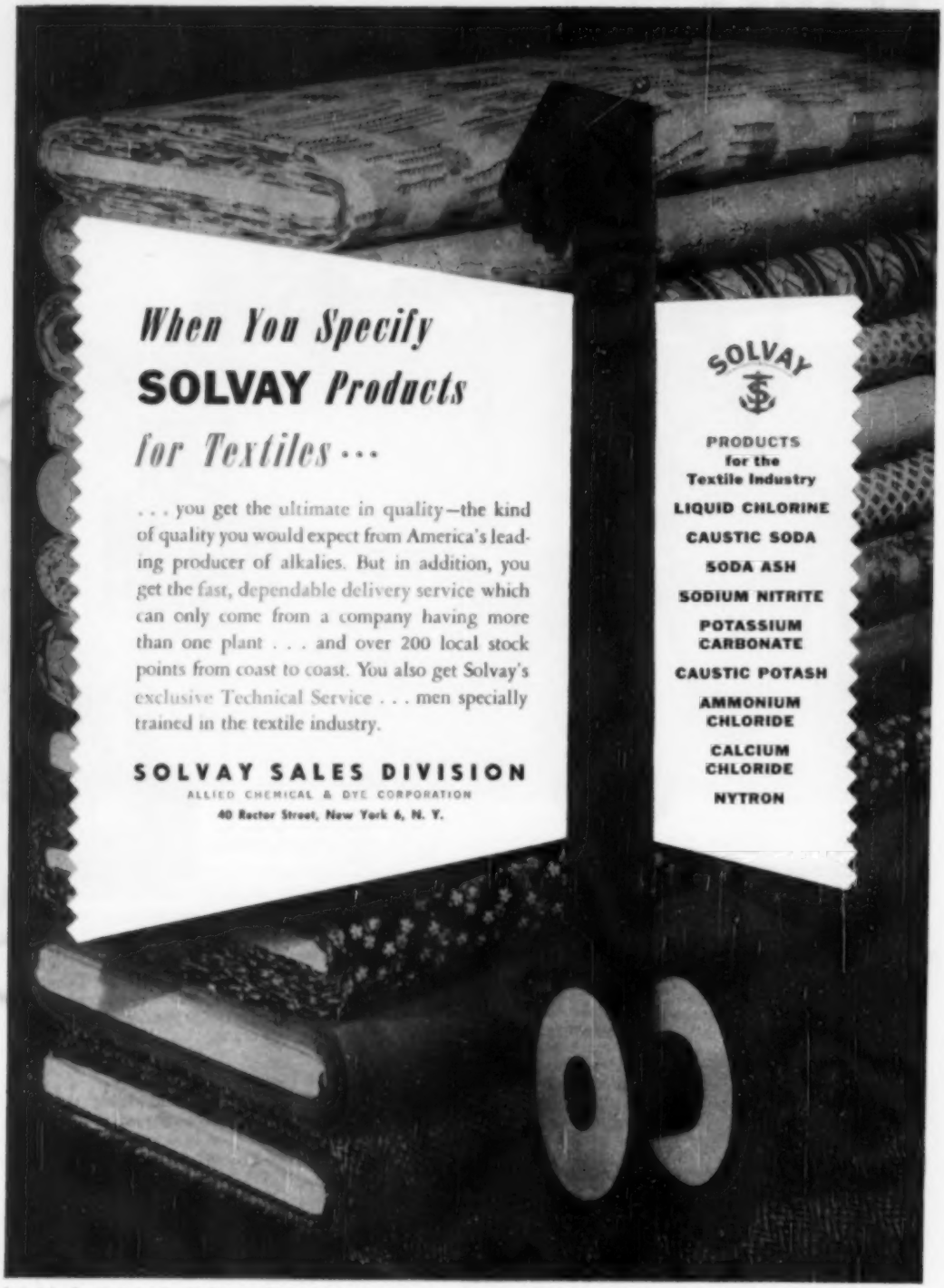
Aloyco valves are furnished in Aloyco 20, 18-8S, 18-8SMO, Monel, Nickel and other alloys. They are manufactured in compliance with the new MSS Stainless Steel Valve Standards.

Aloyco service is nation-wide. Field engineers, backed by complete metallurgical and engineering staffs, are available to assist you in the selection of the best valve and alloy to suit your requirements. This service is yours for the asking.

ALLOY STEEL PRODUCTS CO., Inc.

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Nytron • Ammonium Bicarbonate • Para-dichlorobenzene • Ortho-dichlorobenzene • Monochlorobenzene • Methanol • Ammonium Chloride • Formaldehyde

Armour's products

MYRISTIC ACID

PALMITIC ACID

STEARIC ACID

LAURIC ACID

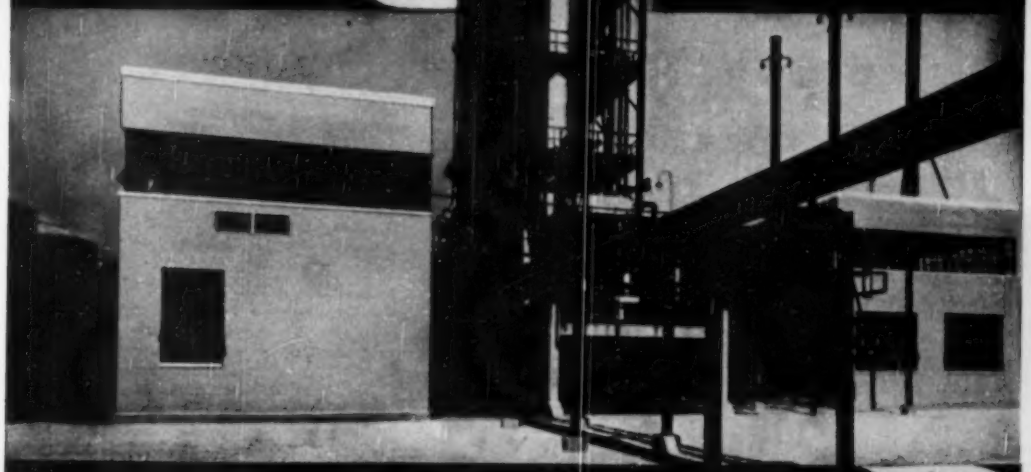
CAPRIC ACID

purity
of product
economy
of operation

Fatty Acid and Nitrile Plant

designed
engineered and
constructed by

Foster Wheeler



The impressive lines of Armour's new Fatty Acid and Nitrile Plant at McCook, Illinois, reflect the most advanced techniques of separating valuable chemicals from ordinary fats and oils.

This plant with auxiliary units manufactures a sizeable proportion of Armour's fatty acids, amides, nitriles, and amines. The long list of important derivatives includes a highly powerful germicide and a chemical which will make low grade iron ore recovery profitable.

Process sections include fractional distillation of fatty acids and nitriles as well as nitrile synthesis units all heated by three 4,500,000 Btu per hour Foster Wheeler Dowtherm Vaporizers. Much of this work was facilitated by earlier pilot plants designed by Foster Wheeler for Armour & Company. The McCook plant has been operating successfully since its completion in late 1949.

FOSTER WHEELER CORPORATION, 165 Broadway, New York 6, N. Y.

ORDINARY FATS AND OILS

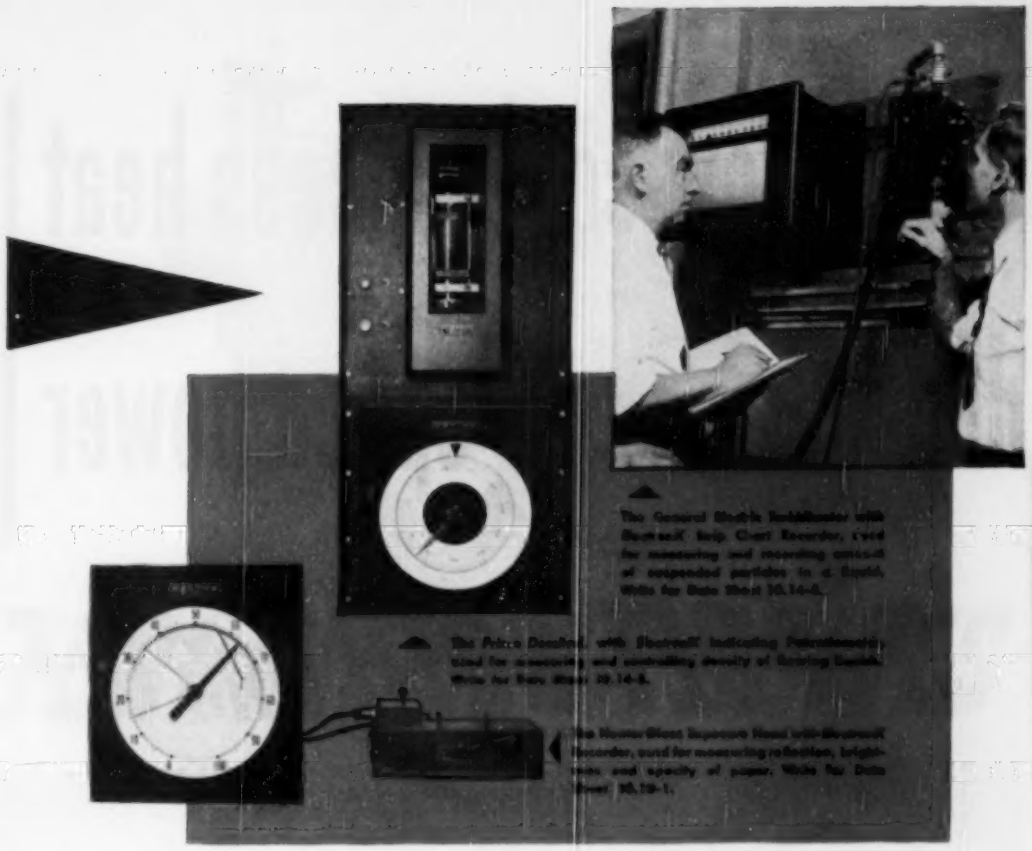
FOSTER WHEELER

FOR THE USUAL OR

THE UNUSUAL

THE VERSATILE *Electronik* POTENTIOMETER





IN PROCESS or laboratory . . . for a standardized operation or a new development . . . if a job requires the ultimate in accuracy, sensitivity, dependability . . . industry invariably turns to the *Electroni*K Potentiometer.

If you require instant and accurate measurement, recording or controlling of variables, you will find the versatile *Electroni*K Potentiometer a "natural" for your application. It is serving with unprecedented efficiency in literally thousands of installations throughout the process industries . . . limited only by the speed with which alert manufacturers take advantage of its remarkable precision, rapid response, unusual ruggedness and complete dependability.

Bulletin B 15-10 describes the adaptability of the measuring circuit, the input circuit and the amplifier of the *Electroni*K Potentiometer. Write for your copy, or call in your local Honeywell engineer for a discussion of your specific application . . . he is as near as your phone.

MINNEAPOLIS-HONEYWELL REGULATOR CO., *Industrial Division*, 4478 Wayne Ave., Phila. 44, Pa. Offices in more than 80 principal cities of the United States, Canada and throughout the world.

MINNEAPOLIS
Honeywell
BROWN INSTRUMENTS

low-cost process heat

dependable low-speed power

GET BOTH with G-E

If your plant uses process steam, you may be able to improve over-all heat balance by driving low-speed equipment with General Electric geared turbines. Mechanical drive turbines act as reducing valves to drop boiler steam pressures down to utilization temperatures for process requirements. With turbines skimming off only a small portion of the steam's heat, mechanical power for driving fans, blowers, pumps and other low-speed apparatus is almost free.

Standard Type DP and DR turbines, combined with General Electric precision-type gears, are ideal for many such applications.

PRECISION GEARING

General Electric balanced-thrust gears are specifically designed for use with turbine drives. Smoothness and quietness of operation are the result of maintaining tooth contours and spacing to a high degree of accuracy.

Positive lubrication assures long life. Oil is delivered to the bearings from a gear-type pump driven by the pinion shaft. The gear mesh is spray-lubricated.

To meet a variety of application requirements, these gears are available in ratios from 1.5 to 10.3.

PRECISION GOVERNING

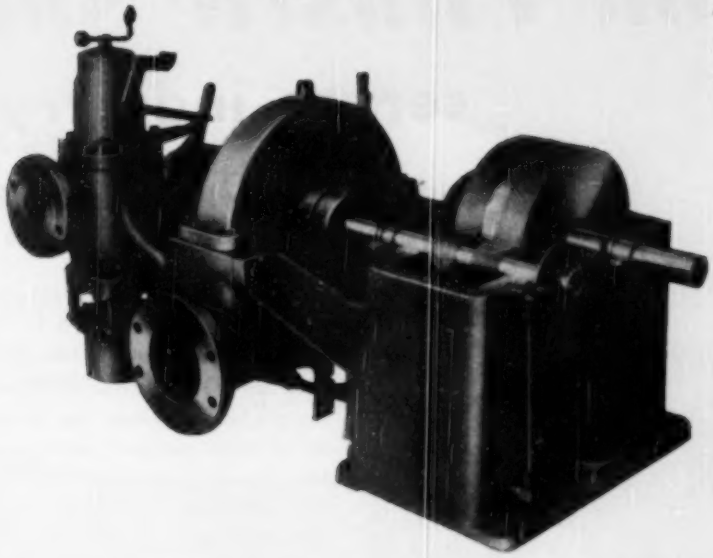
General Electric Type DP and DR turbines include extra features at no extra cost. The DP's hydraulic governing system provides a speed range of 30 per cent with 6 per cent regulation. The DR's oil-relayed governor offers speed ranges up to 5 to 1 with accuracy of ¼ of 1 per cent. Each turbine has its easily operated trip-throttle valve and governing valve combined in one compact unit. Rugged construction from quality materials makes these standard turbines outstanding for reliability and efficiency.

ONE INTEGRAL UNIT

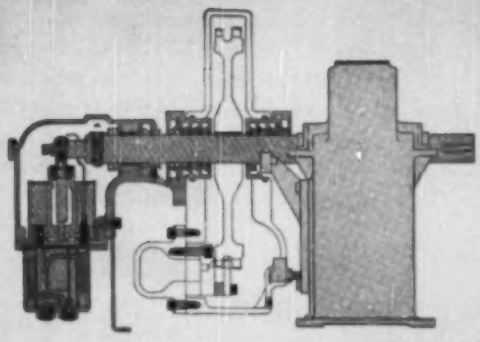
General Electric close-coupled turbine-gear sets have one common turbine and pinion shaft, with the turbine and gear casings solidly connected by a sturdy fabricated bracket. This construction results in a compact unit, does not require high-speed coupling.

Many standard parts are interchangeable with other turbine and turbine-gear drives.

Your nearby General Electric sales office will supply you with full details about mechanical-drive turbine-gear sets. Or, if you prefer, write for free copies of illustrated bulletins on these drives. The DP and DR turbines are described in bulletins GEA-4955 and GEA-5193. Bulletin GEA-5152 contains information about gears. Learn how installing these precision drives in your plant can save you money. Apparatus Department, General Electric Company, Schenectady 5, N. Y.



TURBINE-GEAR DRIVES



HERE'S WHAT STANDARDIZATION PROVIDES FOR YOU

This diagram shows how a standard DP turbine is close-coupled to a low-speed gear using an integral turbine and pinion shaft. All shaded turbine parts are interchangeable on all sizes of DP turbines. Thus, it is easy to stock spares, and maintenance costs are reduced. All individual turbine models and gear sets have standard shaft heights for easy installation or re-location in your plant. In addition, standardization cuts manufacturing expense, and the savings are passed on to you in the form of extra features usually found only on "special" turbine-gear drives.

GENERAL ELECTRIC

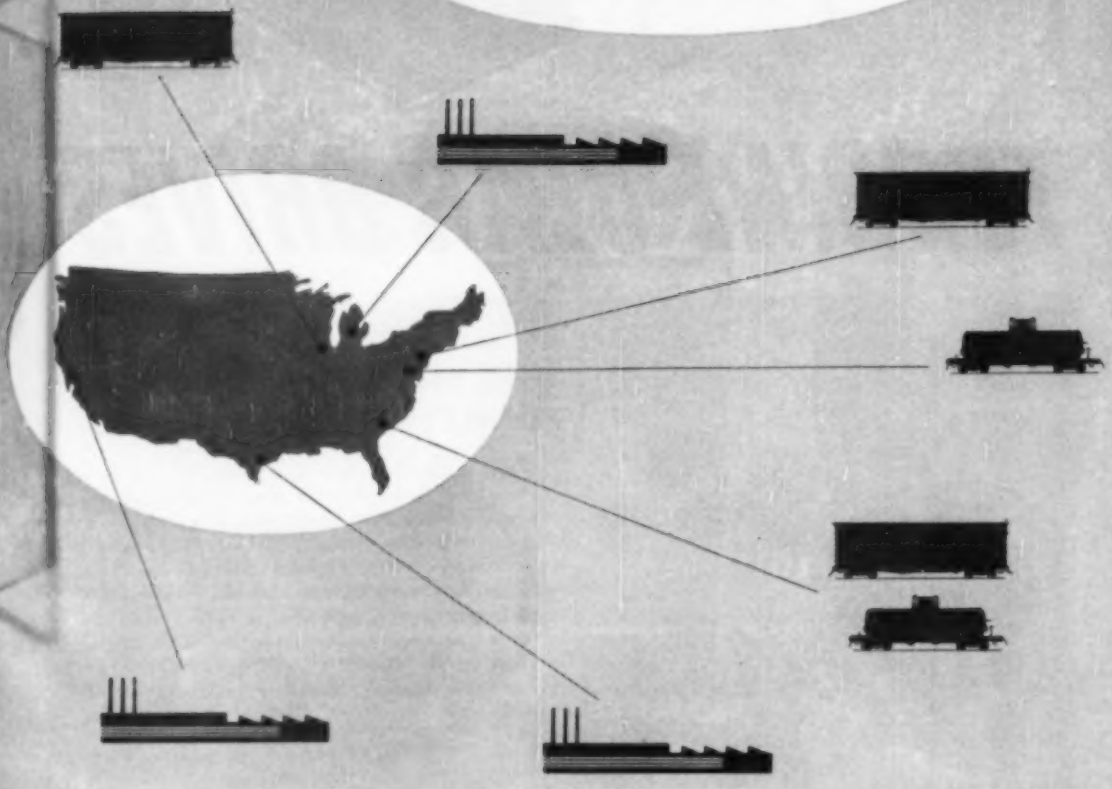
251-07

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serves industry

. . . with unequalled distributing facilities

1. Three producing plants—in Michigan, Texas and California.
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3. Caustic Soda Solid, Flake and Ground Flake terminal distributing facilities—Chicago, Ill., Charleston, S. C., and Port Newark, N. J.



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MIDLAND, MICHIGAN

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St. Louis • Houston • San Francisco • Los Angeles • Seattle
Dow Chemical of Canada, Limited, Toronto, Canada

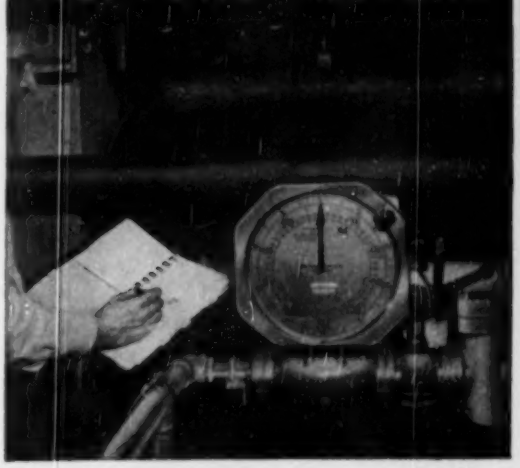
DOW
CHEMICALS
INDISPENSABLE TO INDUSTRY AND AGRICULTURE



Neptune Meters are made for men who are hard-boiled about profits and losses in liquid processing operations. Accurate Neptunes substitute unerring precision for the element of human error. They stop spoilage, spillage, and underfilling. They work fast—no slow weighing or batch tanks. Fine-instrument accuracy gives you constant control over product quality—and also keeps close watch over inventory.

They boost good house-keeping, too. Simple, easy to clean, they keep messy or hazardous liquids inside the pipe. Many types now available for handling more than 100 different liquids—including the new "432" push-button Auto-Stop for automatically feeding water and liquid sweeteners to batching or blending. Composition bronze. Sizes ⅝" to 6", for rates to 600 gpm. Easy to read, easy to operate, easy to calibrate, and easy to service with interchangeable parts. For quick facts, just use the coupon. Or phone the nearest Neptune branch.

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☐ *Rush Bulletin 566*

We're interested in metering

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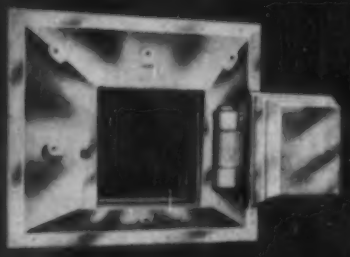
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Company.....

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CUSTOM-BUILT EQUIPMENT For the Chemical and Food Processing Industries



STAINLESS STEEL EQUIPMENT





"RESISTO" LEAD VALVES



COMPLETE LEAD INSTALLATIONS



CUSTOM-BUILT EQUIPMENT for the CHEMICAL and FOOD PROCESSING INDUSTRIES

- Acid Plants
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Fabricators and design engineers of Stainless Steel, Lead, Wood and Steel Equipment for the chemical and food processing industries, O. G. Kelley & Co., have long had the skill and facilities for the toughest, most specialized fabricating problems. Our engineers are at your disposal for consultation without obligation.

"RESISTO" LEAD VALVES

Craftmanship and superior design have established Resisto products as top-notch equipment in the chemical and processing industries. Designed, machined and fabricated for specific purposes, Resisto equipment guarantees dependable, trouble-free service of maximum duration.

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Expert Lead Burning Service at Your Plant or Ours. Specializing in complete lead installations for Acid, Chemical, Rayon, Paper and Textile Plants — Homogeneous Lead Bonded Equipment — Lead X-Ray Protection.

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"Buffalo" Putting the DUST Out of Industry!

- FOR HIGHER PRODUCTION
- FOR QUALITY CONTROL
- FOR IMPROVED WORKING CONDITIONS

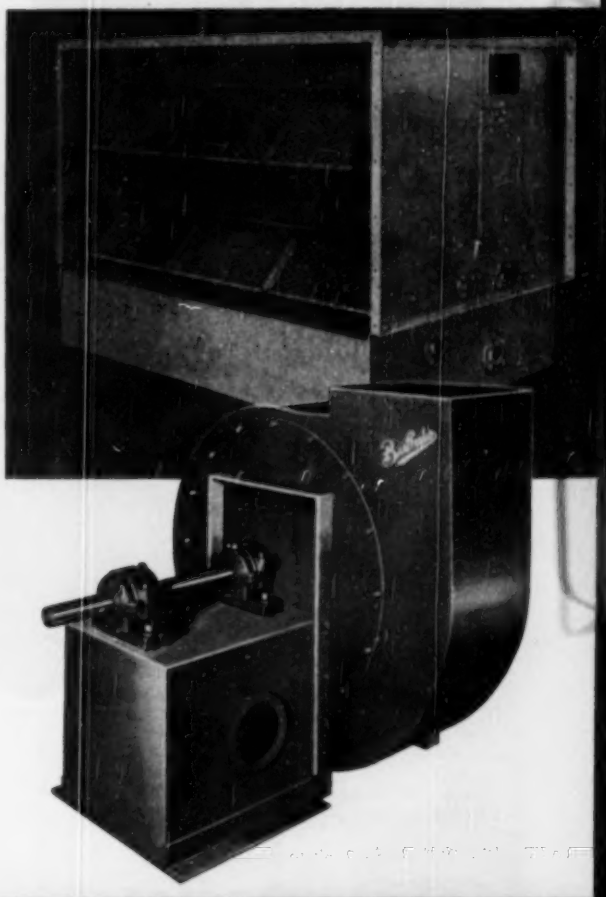
CLEAN PLANT AIR is a definite asset to your business. Not only does it help your public relations, but it is a big factor in your profit picture. And "Buffalo" has the equipment you need to do this cleaning-for-profit job . . . economically . . . and to the specifications you desire.

"BUFFALO" AIR WASHERS

Where your dust content must be held relatively low, "Buffalo" Air Washers can do this job continuously with very low-cost maintenance. For removing over 98% of visible particles, specify "Buffalo" Wet Glass Cell Air Washers, as shown at right. Both types give you humidity control. "Buffalo" Static Washers, still another type, do valuable work in salvaging by-products. WRITE FOR BULLETINS 3142-C and 3417.

"BUFFALO" INDUSTRIAL EXHAUSTERS

The low-cost answer to many a dust control problem, these exhausters have a reputation for requiring little maintenance and lasting long on the job. Sturdy, efficient all-welded design for continuous exhausting or conveying work.



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Canadian Blower & Forge Co. Ltd., Kitchener, Ont.

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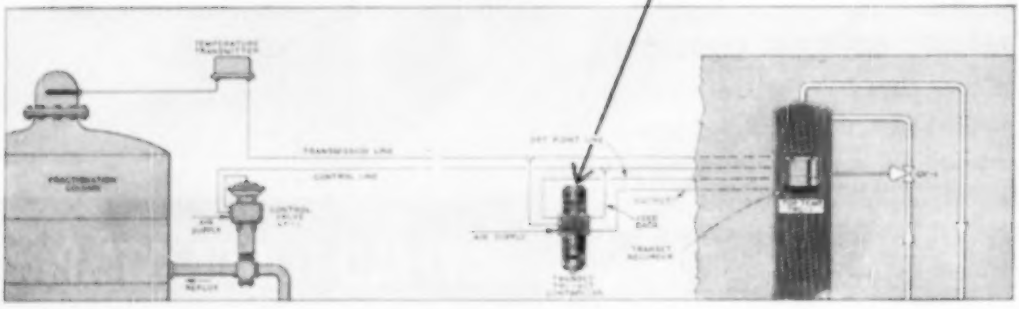
OPTIONAL MANIFOLD (Self-sealing) permits removal of instrument without disconnecting air lines —for easier, low-cost maintenance.

ORIFICE CLEANERS

CONVENIENT RESPONSE ADJUSTMENTS calibrated in specific units of measurement for easy tune-in.

HIGH CAPACITY AIR VALVE for faster response of control circuit to capitalize on faster measuring systems.

SCHEMATIC DRAWING of fractionation column shows function of Transet Tri-Act Controller and its relation to the Transaire Temperature Transmitter, Transet Recorders, and Transet Indicators, in the new Transet Process Control System.



New Taylor Transet*

TRI-ACT* CONTROLLER!

A Force-Balance Controller with a New Circuit

. . . a New Concept in Process Control

GIVES YOU

1. START-UP WITH *NO* OVERPEAKING
2. BENEFITS OF AUTOMATIC RESET WITHOUT ITS "EVILS"
3. FASTER RECOVERY ON LOAD CHANGES

What It Is—A force-balance controller with a new circuit for pneumatic control systems. The new control circuit combines *two* proportional bands, one with rate action in a closed loop ahead of automatic reset. The first band is shifted by the rate action, and the second band is shifted by the automatic reset. This provides control never before believed possible.

What It Does—The new circuit in the TRANSET TRI-ACT Controller permits 4 times faster reset rate and 4 times faster rate action (PRE-ACT) than conventional instruments! The composite effect of the three responses allows start-up and pneumatic setting with No OVERPEAKING! The faster response settings allow the use of rate and reset responses, *with stability*, on processes where these effects were needed but could not be used.

OTHER HIGHLIGHTS

- Can be locally or panel mounted
- Wider range of response adjustments
- Light weight
- Built-in air strainers

TRANSET TRI-ACT Controller is the latest step in the TAYLOR TRANSET/system of control: TRANSAIRE* Transmitters, TRANSET Recorders and Indicators. It creates new standards in accurate pneumatic transmission systems for temperature, pressure, flow or liquid level control.

Write for Bulletin 98097 or, better still, order now from your Taylor Field Engineer! Taylor Instrument Companies, Rochester, N. Y., or Toronto, Canada.

Instruments for indicating, recording and controlling temperature, pressure, humidity, flow and liquid level.

*Trade-Mark

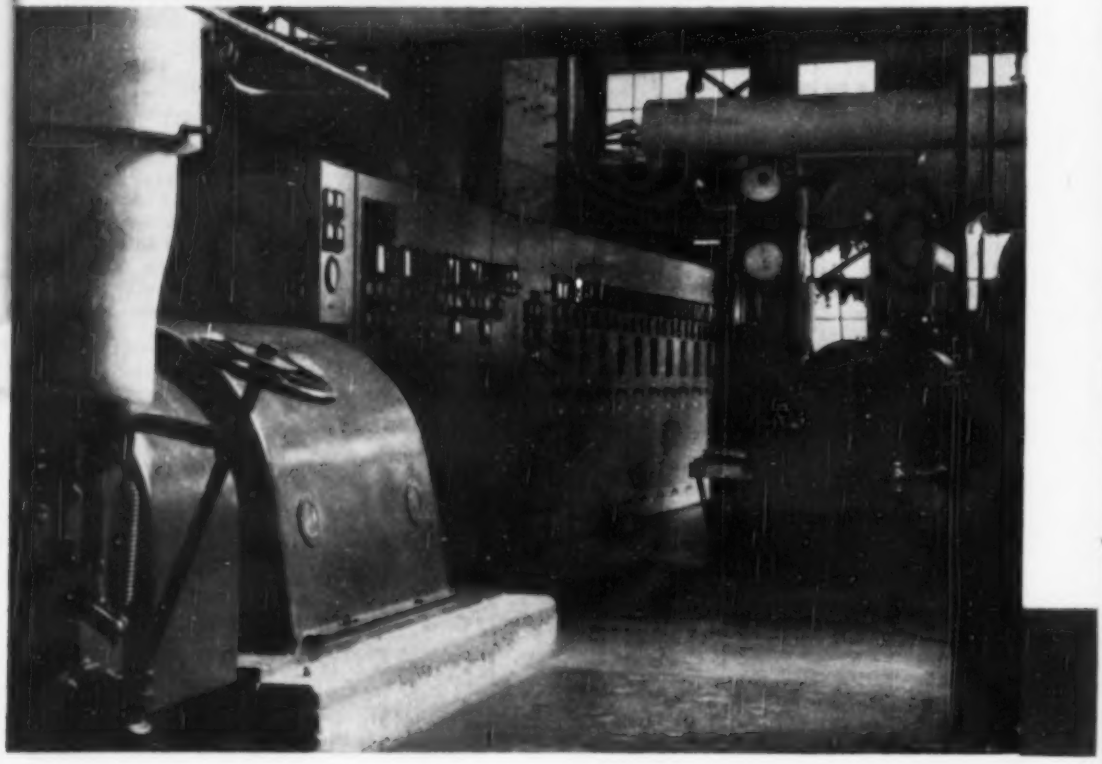
Taylor Instruments
MEAN
ACCURACY FIRST
IN HOME AND INDUSTRY

FREEPORT SULPHUR EXPANDS



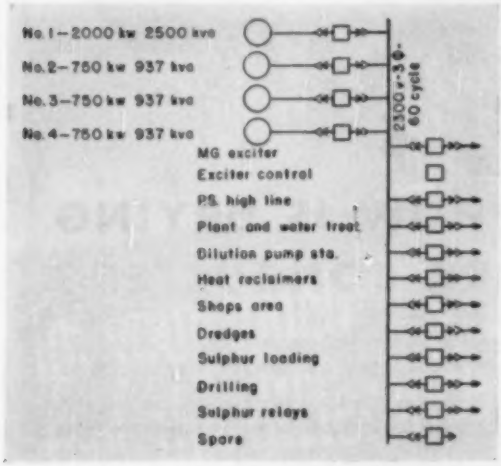
This inadequate, open-type switchgear was replaced by the new G-E Metal-clad equipment shown below. Freeport Sulphur officials recognized that the old switchgear had outgrown its usefulness.

Here's the new General Electric 5-kv Metal-clad switchgear installed at Freeport Sulphur. Magne-blast power circuit breakers have plenty of "IC" (Interrupting Capacity) to handle all short circuits that may occur on Freeport's expanded distribution system. This assures continuous power for vital production.



AND MODERNIZES WITH

METAL CLAD SWITCHGEAR



This one-line diagram shows power distribution at Freeport Sulphur as planned by Sargent and Lundy, consulting engineers of Chicago. General Electric Metal-clad switchgear handles the 2300-volt power from the generators through power circuit breakers of 100,000-kva interrupting rating.

The Freeport installation is a complete General Electric project—one source of responsibility plus the very best in co-ordinated planning, engineering, manufacturing, and service facilities to give maximum savings and efficiency to the customer.

Be sure to see the "More Power to America" full-color sound slide-film "Modern Industrial Power Distribution." Ask your G-E sales representative to arrange a showing for your organization.

WHEN Freeport Sulphur expanded their production facilities they put in a new turbine to take care of the increased load.

At the same time they replaced all their old equipment with General Electric switchgear.

When you order G-E switchgear you get all the equipment and service from one reliable source. And with everything pre-assembled at the factory it takes very little time to get the switchgear in place and operating.

MODERN INDUSTRIAL power distribution systems using G-E switchgear are applicable to any industrial plant or commercial building where you want. . . .

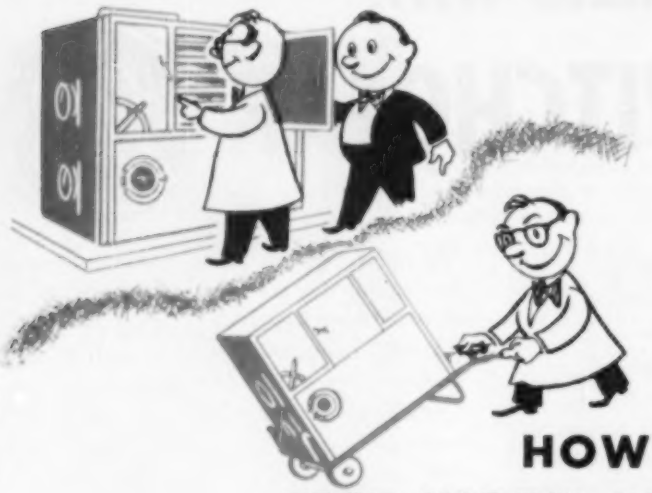
- Proper voltage for top performance of equipment
- An extremely flexible setup to take care of expanding or changing loads
- Adequate short-circuit protection
- Protection for personnel
- Low installation and maintenance costs

INVESTIGATE TODAY the many advantages of using General Electric switchgear to get the same benefits gained by Freeport Sulphur. Contact your G-E sales representative for further information—or write for the helpful bulletins listed below. *Apparatus Department, General Electric Company, Schenectady 5, New York.*

GEA-3083 Metal-clad Switchgear
GEA-4966 Low-voltage Metal-enclosed Switchgear
GEA-3592 Load-center Unit Substations
GEA-3758 Load-center Power Distribution

GENERAL ELECTRIC

TIPS ON SOLVING DRYING PROBLEMS—NO. 4



HOW IS DRYING TEST WORK CONDUCTED?

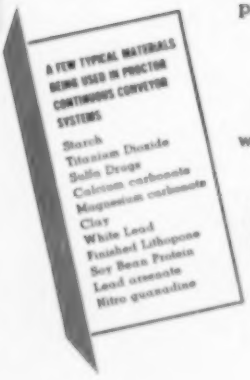
Drying test work conducted for you by Proctor engineers varies, of course, with different products and problems—but generally follows a somewhat standard pattern.

Test work is conducted in modern laboratories where Proctor research engineers have at their disposal, all of the latest data and equipment to assist them in ascertaining the information necessary to enable the preliminary engineering department to prepare plans for the basic type and size of equipment best suited to the individual problem.

In some cases it is impossible, because of the physical characteristics of the product to be studied, to transport the product to the Proctor laboratories. For example, the composition may change in transit. In such cases, Proctor engineers will come to your plant—and may arrange to have a laboratory dryer, like those used in the Proctor laboratories, sent to your plant for use in conducting on the spot research. Usually there is no charge for any research conducted by Proctor engineers.

Based on the findings of this research, skilled Proctor engineers make preliminary plans for the type of and size of equipment needed to meet your requirements. This is submitted to you for approval, together with a quotation of price. Having reached that stage, you are well on the way to guaranteed results.

For the complete story of the Proctor approach to solving drying problems, write for Bulletin 361. For a lucid explanation of Proctor Job Engineered Drying Systems for the Process Industries, ask for Bulletin 342 as well.



PROCTOR CONTINUOUS CONVEYOR SYSTEMS

PROCTOR & SCHWARTZ INC • 711 TABOR ROAD • PHILADELPHIA 20 • PA •



let your touch feel the difference

Feel the inside of a Gardner-Denver Centrifugal Pump—and you know one of the big reasons why Gardner-Denver Centrifugals rank high in efficiency—why they save pumping costs year after year. Their extremely smooth water passages are correctly proportioned and cast with special care. You feel nothing to impede the smooth flow of water through the pump—nothing to cause power-robbing eddies and backwaters.

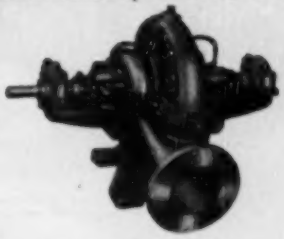
For extra pump value, insist on Gardner-Denver quality. For expert assistance on your pumping problems, write Gardner-Denver Company today.

GARDNER-DENVER *SINCE 1859*

Gardner-Denver Company, Quincy, Illinois

In Canada: Gardner-Denver Company (Canada), Ltd. Toronto, Ontario.

QUALITY PUMPS by GARDNER-DENVER



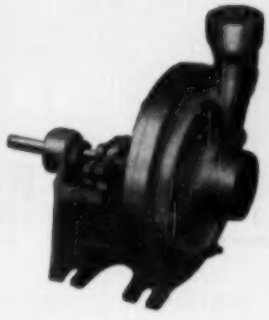
BIG CAPACITY PUMPS Horizontally split case, double-suction — ruggedly constructed—easy to service—for all heads up to 300 ft.

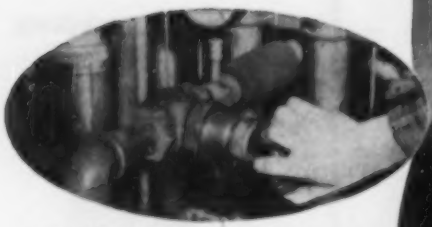


SPACE SAVING PUMPS Close coupled — for mounting in any position — for capacities to 1200 g.p.m.—heads up to 250 ft.



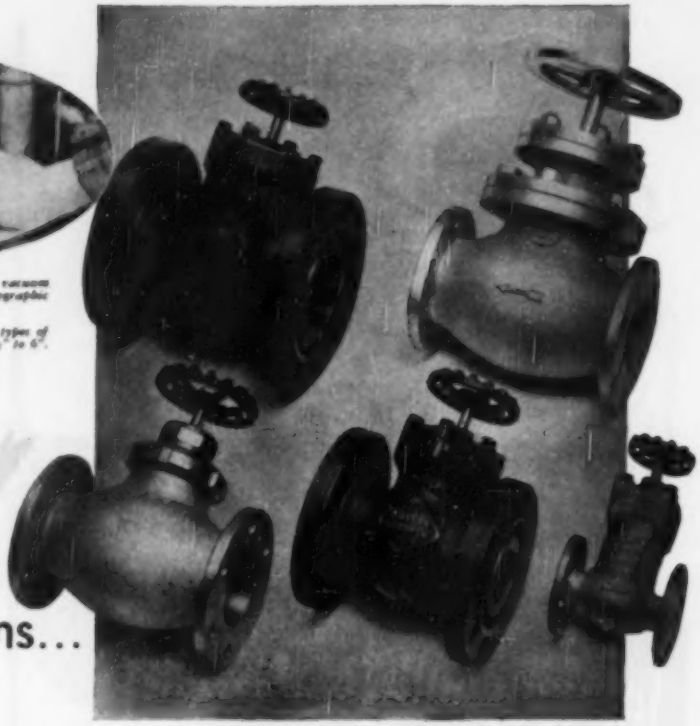
SIDE-SUCTION UTILITY PUMPS Sealed ball bearings are factory lubricated — never need greasing — for capacities up to 3000 g.p.m. and heads up to 100 ft.





(Above) FulSeal packless valve carries high vacuum on lines in plant of an incandescent and photographic bulb manufacturer.

Illustrated at right — a few of the many types of FulSeal packless valves. Sizes range from ⅛" to 6". For vacuum service, No. 304-NV is ideal.



If gas or liquid leaks are problems...

FULSEAL packless valves will lick 'em!

INSTALLED on pipe lines carrying oil, gasoline or other volatile liquids or vapors, FulSeal packless valves stop leakage — prevent wastage — provide vacuum protection, too.

And they give you and your equipment an added safety advantage . . . protection against fire, explosion, toxic vapors or other hazard.

FulSeal packless valves do away with leakage and replacement of packing forever! There *isn't* any packing. A rugged, seamless metal bellows replaces the customary stuffing box, provides a seal that assures a permanent, "leak-proofing" job. And, it seals the valve stem against corrosive, dangerous or inflammable liquids or gases.

FulSeal packless valves are available in many sizes and types. They're used in many industries — chemical plants, oil refineries, power plants, aboard ships. For complete information, write for Bulletin VC-813.

FS

FIRST WITH BELLOWS

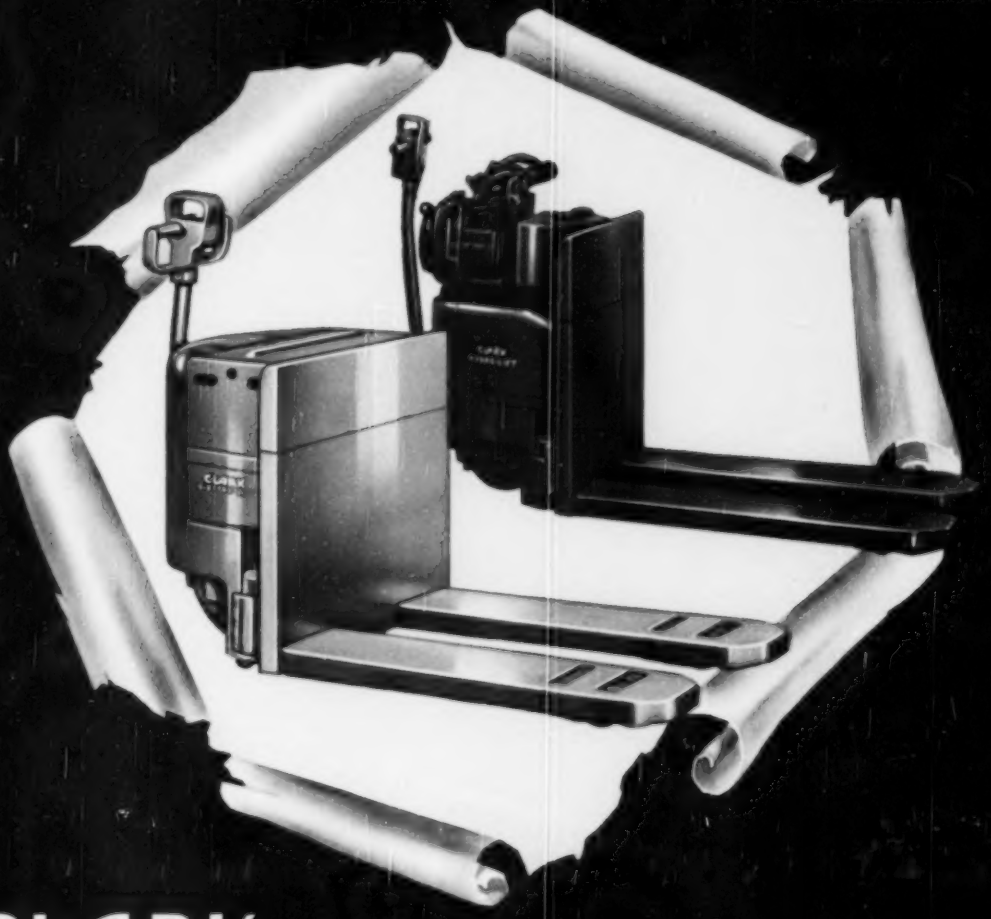
Temperature Controls • Bellows Devices • Bellows Assemblies

FULTON SYLPHON
DIVISION

ROBERTSHAW-FULTON CONTROLS CO. KNOXVILLE 4, TENN

Canadian Representatives, Darling Brothers, Montreal

NO OTHER HAND TRUCK HAS
SO MUCH POWER – SO SHORT A TURNING RADIUS!
PLUS TWO POWER TYPES – GAS OR ELECTRIC



CLARK
POWERED HAND TRUCKS

TURN PAGE FOR MORE HAND TRUCK DETAILS

CLARK EQUIPMENT COMPANY, INDUSTRIAL TRUCK DIVISION
BATTLE CREEK, MICHIGAN

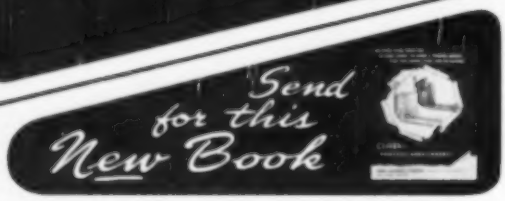
The NEW CLARK POWERED HAND TRUCKS

with the motor in the drive wheel

SHORTEST TURNING RADIUS — GREATEST POWER







TWO POWER TYPES

1 ELECTRO-LIFT

BATTERY POWER—ELECTRIC MOTOR DRIVE

New-type compound motor develops *more* power than any other hand truck . . . Economical consumption of power means longer work periods . . . Ample reserve power available when required . . . Automatic acceleration prevents abuse, provides smooth, fast "getaway" . . . Speed variations are slight with or without load—reducing operator fatigue . . . Soft, dynamic braking protects loads . . . Lift motor, pump, relief valve, check valve and sump in single compact unit . . . The *only* short truck with space for batteries up to and including 19-plate.

2 HYDRO-LIFT

GAS-ENGINE POWER—HYDRAULIC MOTOR DRIVE

Entirely new in the field of Materials Handling . . . 24-hour ramp service every day! . . . Hydraulic power infinitely smoother than any other type . . . Heavy-duty vane-type hydraulic units for continuous efficiency and long life . . . Effortless finger-tip reversal of direction . . . Automatic torque multiplication assures ample reserve power when needed . . . Hydraulic pump powers both drive and lift.

Compare CLARK machines with any and all others of their type! You'll find they excel because they give you:

- *Shortest turning radius*
- Shortest wheel base, giving better load distribution
- Greater underclearance to prevent "hanging up"
- Greatest accessibility for maintenance
- Reduced wear on rubber and floor because of larger (14") drive tire. This tire carries greater load, relieving burden on rollers
- Drive motor *mounted in the wheel*
- Compact, fully enclosed drive unit
- Lifting rams self-aligning and instantly accessible
- Rugged frame, and largest main carrier bearing
- Largest mechanical brake

The full story of these Clark Quality trucks, designed to *give industrial users what they want*, is told in a booklet that is yours for the asking. Just fill in the coupon, attach it to your letterhead and mail it.

CLARK ELECTRIC AND GAS POWERED **FORK TRUCKS** AND INDUSTRIAL **TOWING TRACTORS**



INDUSTRIAL TRUCK DIVISION • CLARK EQUIPMENT COMPANY • BATTLE CREEK 67, MICH.

Please send me the new Hand Truck Booklet

Name _____

Firm Name _____

Street _____

City _____ Zone _____ State _____

PRODUCTS OF CLARK—TRANSMISSIONS • FORK TRUCKS & TRACTORS • AXLE HOUSINGS • GEARS AND FORGINGS • RAILWAY CAR TRUCKS • ELECTRIC STEEL CASTINGS • AXLES • TRACTOR UNITS

in the purification of water and other solutions by ion-exchange . . .



the successful operating plant

must be an "ENGINEERED" job.

In a Dorrco D-I System, you buy far more than steel and piping . . . resins and controls. You buy an "engineered" job from problem analysis to initial operation . . . tailor-made to fit your particular conditions . . . geared to operate at maximum efficiency. First step in the consideration of any large scale ion-exchange operation is a fact-finding evaluation of all phases of the problem. At this point, our experience with the "engineered" job will prove a useful supplement to your own knowledge.

DORRCO

THE DORR COMPANY, ENGINEERS
BARRY PLACE, STAMFORD, CONN.

NEW YORK • ATLANTA • TORONTO
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RESEARCH AND TESTING LABORATORIES
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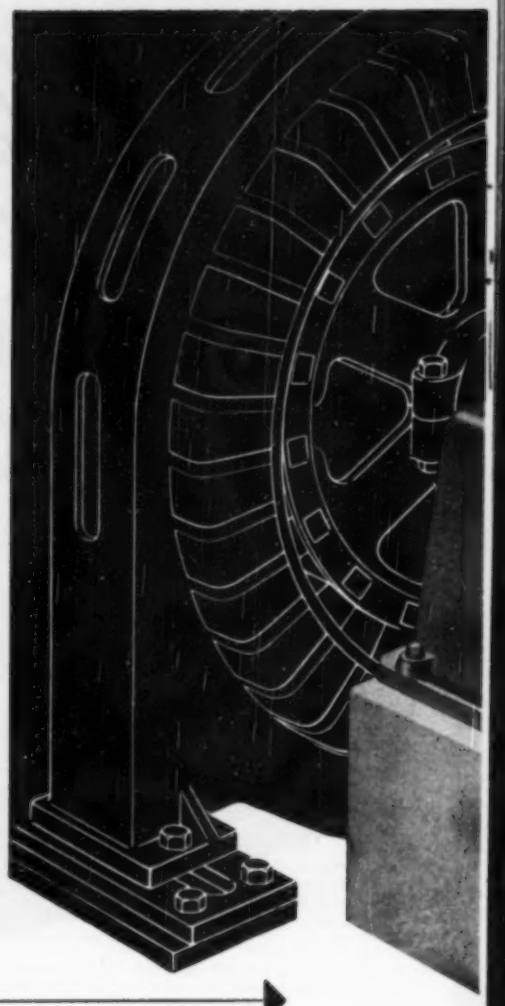
SUGAR PROCESSING
PETREE & DORR DIVISION, STAMFORD, CONN.

ASSOCIATES AND REPRESENTATIVES
Dorr Technical Services and Equipment Are Also Available Through Associated Companies and Representatives in the Principal Cities of the World. Names and Addresses on Request.

RESEARCH ENGINEERING EQUIPMENT

DORR

FIRST with roller bearings THROUGHOUT



IN A HORIZONTAL DUPLEX COMPRESSOR

- SPHERICAL ROLLER MAIN BEARINGS
- SPHERICAL ROLLER CRANKPIN BEARINGS
- HEAVY-DUTY NEEDLE BEARINGS AT CROSSHEAD

Chicago Pneumatic's Class O-CE AIR COMPRESSORS are the first horizontal duplex, side crank compressors to have anti-friction roller bearings throughout . . . spherical roller main and crankpin bearings . . . heavy-duty needle bearings at the crosshead pins.

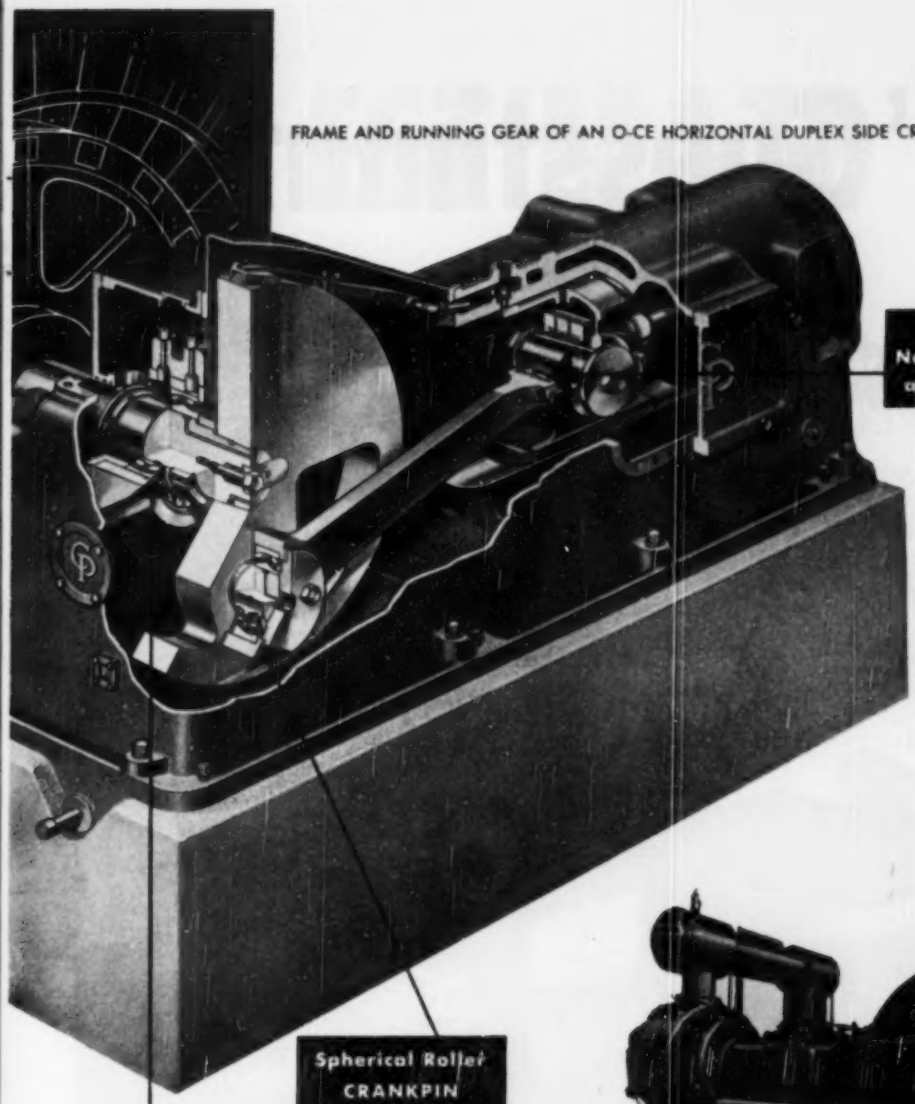
To the user, "roller bearings throughout" means easier and cheaper maintenance, and no possibility of improper bearing adjustment with resultant serious damage to frame and running gear.

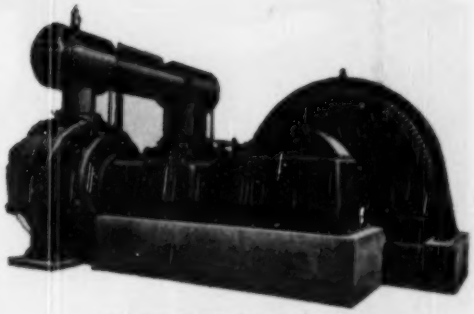
Roller crankpin bearings permit the use of solid-end connecting rods—the strongest, safest type.

This revolutionary innovation is made possible by the recent development of the oil injection method of bearing and crank disc installation and removal. This simple method, requiring only a hand-operated oil pump and ordinary hand tools, is employed also for the application or removal of gears, couplings and sleeves on shaft ends.

Class O-CE Motor-driven Compressors are furnished in sizes up to 2000 h.p.

FRAME AND RUNNING GEAR OF AN O-CE HORIZONTAL DUPLEX SIDE CRANK COMPRESSOR





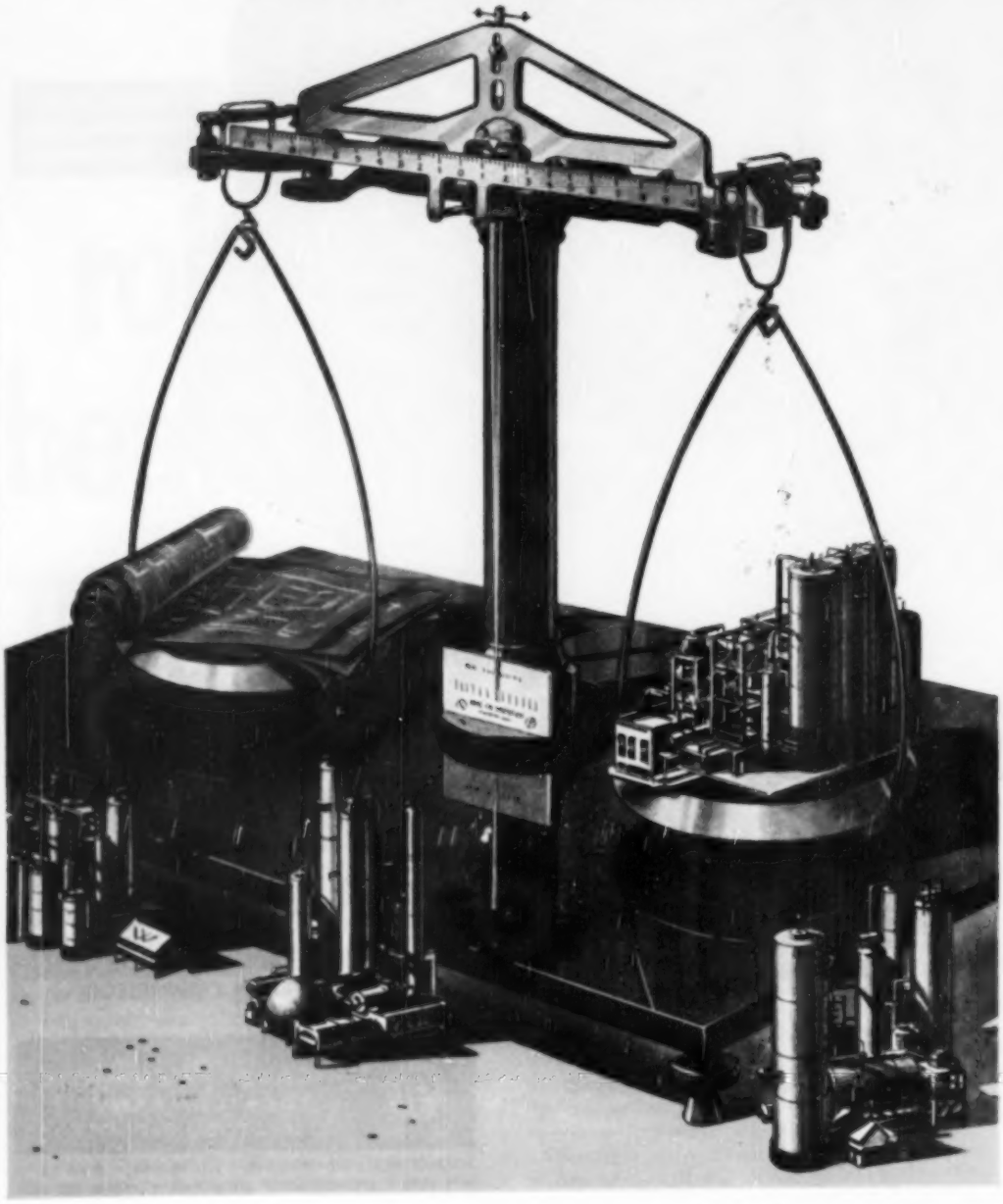
CLASS O-CE TWO-STAGE MOTOR-DRIVEN COMPRESSOR

Write for Bulletin 726-5

CHICAGO PNEUMATIC TOOL COMPANY

PNEUMATIC TOOLS • AIR COMPRESSORS • ELECTRIC TOOLS • DIESEL ENGINES
ROCK DRILLS • HYDRAULIC TOOLS • VACUUM PUMPS • AVIATION ACCESSORIES

"Guesstimate"



or ESTIMATE

Before considering plant expansion or new construction, manufacturers in the process industries must have assurance today that the final cost of a new plant will bear reasonable relationship to the initial appropriation.

Badger is able to give valuable assistance in making rational and adequate estimates of cost, based on current experience in the design and construction of similar plants in all parts of the world.

Badger's realistic cost estimates are backed by proved ability to handle in time and money saving scheduled sequence the myriad details involved in the design, engineering and erection of all types of process plants for the petroleum, chemical and petro-chemical industries.



E. B. BADGER & SONS CO · Est. 1841

A SUBSIDIARY OF STONE & WEBSTER, INC.

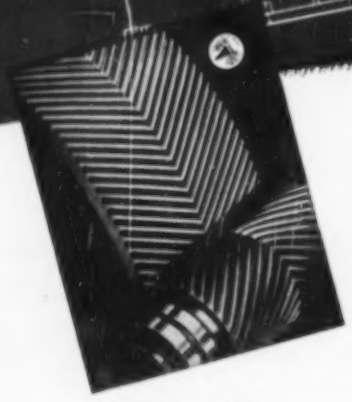
BOSTON 14 · NEW YORK

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Process Engineers and Constructors for the Petroleum, Chemical and Petro-Chemical Industries

SPEED REDUCERS . . .





STANDARD IN PRINCIPAL FEATURES BUT ADAPTABLE IN CRITICAL DETAIL

Farrel speed reducers have been developed for continuous, trouble-free operation under difficult service conditions. Gears, shafts and bearings are factored to safeguard against interruption of vital processes; gear cases are proportioned to withstand repeated heavy peak loads; joints are sealed to prevent entrance of dust and dirt.

But, that is not all. Without sacrificing the advantages of general standards, the design of these units permits an engineering freedom in proportioning gears, shafts, bearings and even some housing dimensions to meet specific load, speed and service requirements. This flexibility allows an engineering exactness in critical detail, which has resulted in the solution of innumerable application problems.

Write for further details. Ask for a copy of Bulletin 449—no cost or obligation.

FARREL-BIRMINGHAM COMPANY, INC. • ANSONIA, CONNECTICUT

Plants: Ansonia and Derby, Conn., Buffalo, N. Y. *Sales Offices:* Ansonia, Buffalo, New York, Boston, Pittsburgh, Akron, Cleveland, Cincinnati, Detroit, Chicago, Los Angeles, Tulsa, Houston, New Orleans.

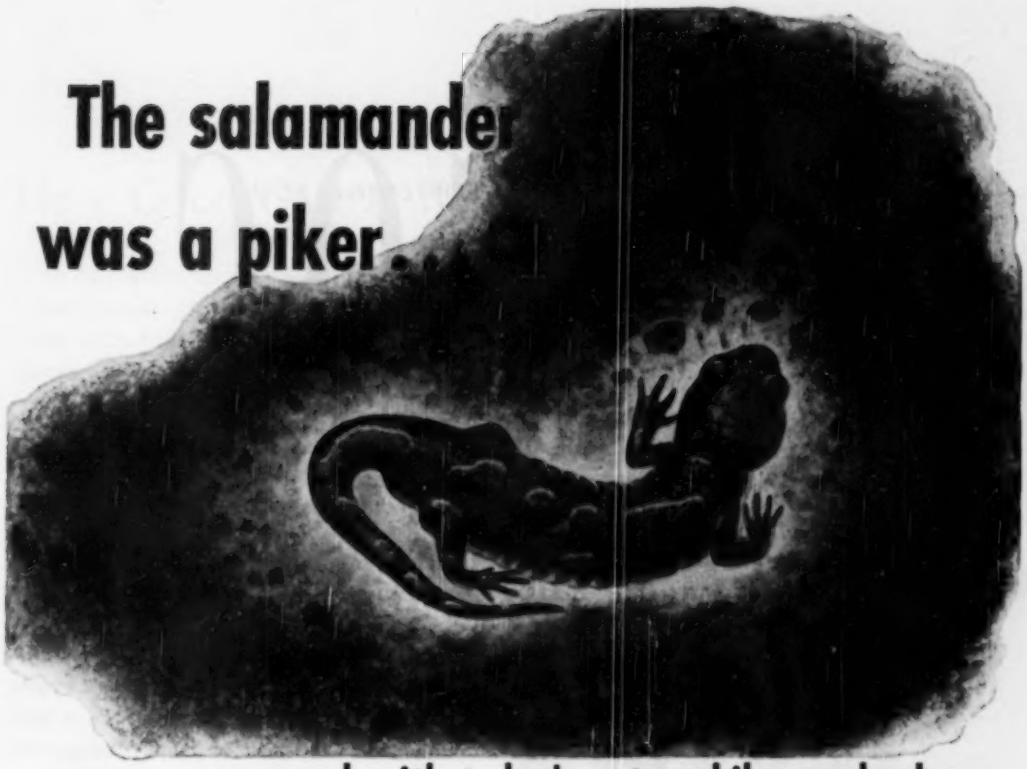
FB-592-A

PRECISION GEARS

The quiet, vibration-free performance you can expect from the herringbone gears used in Farrel speed reducers results from extreme accuracy of tooth spacing, contour and helix angle . . . qualities inherent in the Farrel-Sykes method of gear generation. Precision manufacture and highest grade materials contribute to long gear life.

Farrel-Birmingham®

The salamander was a piker...



compared with today's automobile spark plugs



Salamanders could withstand fire without harm, the ancients believed. Benvenuto Cellini wrote that his father, looking into the fire, "spied in the middle of those most burning flames a little creature like a lizard, which was sporting in the core of the intensest coals." He pointed it out as a *salamander*, never seen before "by any one of whom we have credible information."

Even if the salamander *could* withstand fire—a supposition long since proved a myth—its heat-resistance could not compare with that of the modern automobile spark plug.

As often as 30 times a second, the spark-plug "porcelains" in your car resist alternate exposure to cold, raw gas and 4,000° F. burning fuel.

They must also resist 8,000 volts of electricity, the pressure of extremely tight assembly, the corrosive effects of modern fuels. They must not crack or even soften.

And finally, the principal material for these porcelains must be cheap and abundant.

Alcoa Tabular Alumina—a specially refined, pure form of aluminum oxide—meets all these specifications.

So, although operating conditions have grown more severe, spark-plug insulator breakdown has almost vanished. That has been the contribution of Alcoa Tabular Alumina to the practicability of high-compression engines of today and higher ones tomorrow.

Unmatched characteristics of this inert material have already suggested other uses for Alcoa Tabular Alumina: Ceramic bodies—super-duty refractories—special cements—grinding balls—laboratory ware—"pebbles" for heat exchangers—catalyst-bed supports—and others, including many still in the "laboratory" stage.

Profitable applications in your business for the physical, chemical, thermal or electrical properties of Alcoa Tabular Alumina may be suggested by our brochure, "The Salamander was a Piker." It describes Alcoa Tabular Alumina—Its Properties and Uses. Write for it. Aluminum Company of America, Chemicals Division, 602L Gulf Building, Pittsburgh 19, Pennsylvania.

Alcoa Chemicals

ALCOA

ALUMINAS and FLUORIDES

ACTIVATED ALUMINAS • CALCINED ALUMINAS • HYDRATED ALUMINAS • TABULAR ALUMINAS • LOW SODA ALUMINAS ALUMINUM FLUORIDE • SODIUM FLUORIDE • SODIUM ACID FLUORIDE • FLUOBORIC ACID • CRYOLITE • GALLIUM

PROBLEM...

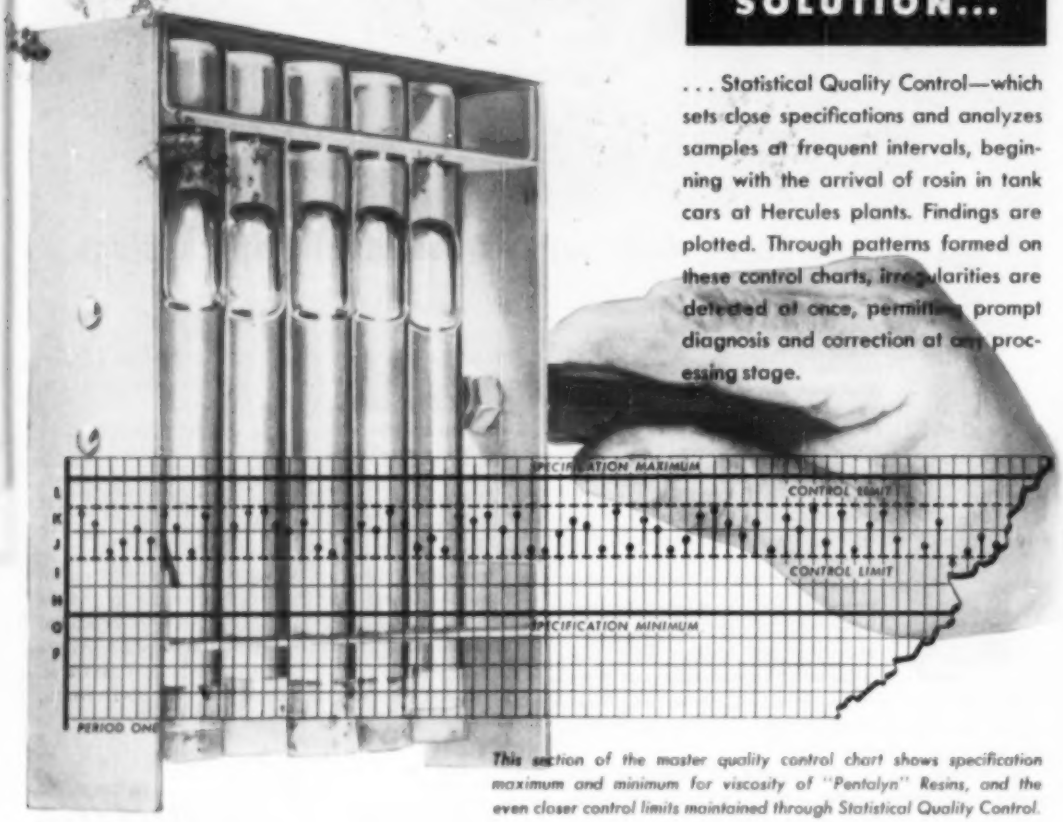
. . . to make good resins even better through closer control over the various steps in manufacture that influence viscosity, acid number, melting point, color, and other important properties.

S.Q.C.

SOFTENING POINT
COLOR
ACID NUMBER
VISCOSITY

SOLUTION...

. . . Statistical Quality Control—which sets close specifications and analyzes samples at frequent intervals, beginning with the arrival of rosin in tank cars at Hercules plants. Findings are plotted. Through patterns formed on these control charts, irregularities are detected at once, permitting prompt diagnosis and correction at any processing stage.



This section of the master quality control chart shows specification maximum and minimum for viscosity of "Pentalyn" Resins, and the even closer control limits maintained through Statistical Quality Control.

HERCULES SYNTHETIC RESINS · CELLULOSE PRODUCTS · TERPENE CHEMICALS

How Good Can A Resin Be?

With Statistical Quality Control, Hercules has been able to make good resins even better. There is promise, too, of continually improved resins, since quality control enables specification limits to be narrowed.

One result of quality control is the even higher standard of uniformity obtained for Hercules Pentalyn® Resins. Derived from rosin, the "Pentalyns" offer a series of synthetic resins—each resin developed for specific needs and differing widely in chemical and physical properties, yet each consistent in its individual characteristics, batch after batch.

We would like to tell you more about Hercules synthetic resins and what Statistical Quality Control has done to improve their usefulness in solving *your* processing problems.

HERCULES POWDER COMPANY *952 Market Street, Wilmington, Delaware*
Sales Offices in Principal Cities

RESULT...

. . . resins with a uniformity and consistent quality entirely new to the chemical industry. Customers now can select resins with the same confidence they select any chemical bought on a strict purity basis.





Versatile New Ether

Hydroxyethyl Cellulose is an alkali-soluble, water-insoluble cellulose ether of good film-forming properties. Density 1.49 gm/cc and refractive index 1.534. In film form, at 25°C. Hydroxyethyl Cellulose is a white, tasteless, odorless, fibrous solid, insoluble in all common organic solvents, oils, fats, and greases; soluble in alkalies—e.g. 2% to 18% NaOH; 5% to 18% KOH. This new material is suitable as a starch replacement in flotation, a thickener for alkaline adhesives and resin solutions, a filler for thermosetting resins, a binder for paper coatings, a permanent size in textiles and a toughener for flocs used in water treatment. Other possible applications include textile printing media, inks, leather coatings. Two viscosity types are available.

Microlab Speeds Research

With the addition of a new microanalytical laboratory to Hercules' research facilities, Hercules' chemists now are able to obtain data which otherwise could not be achieved without repeating syntheses on a large scale. In the new lab, midget-sized micro flasks, funnels and crucibles yield accurate data in grams to the fifth and sixth decimal places. Air is filtered free of dust and kept at a constant 70° temperature and 50% relative humidity, thus eliminating errors arising from variations in these conditions.

Resin Emulsion Stabilizer

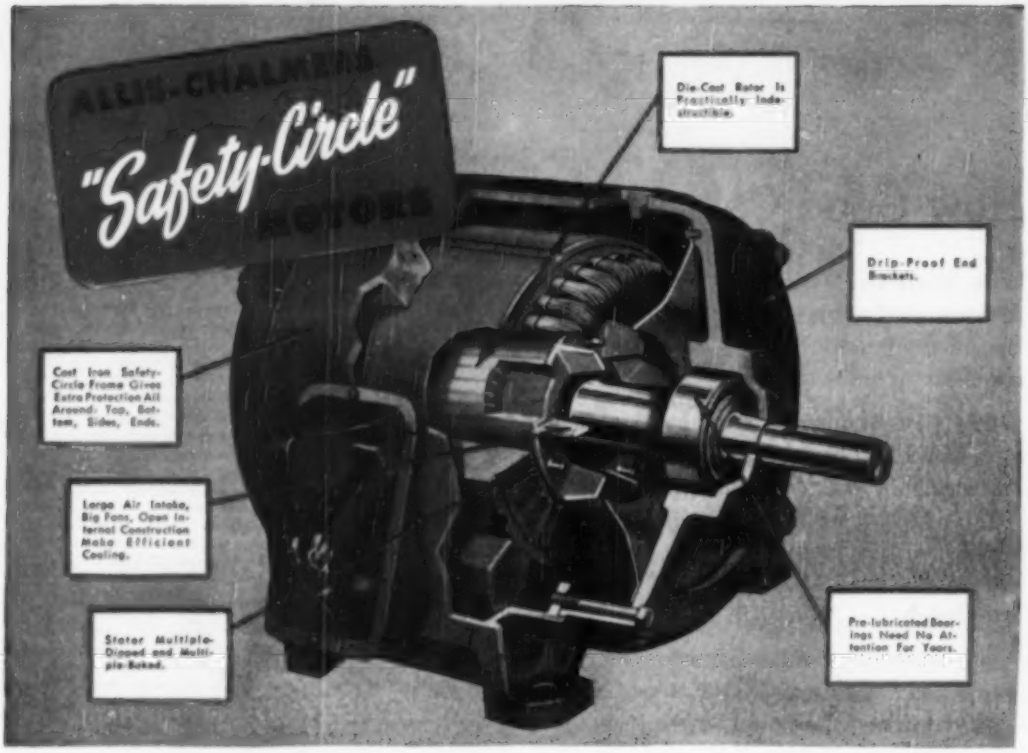
Hercules® CMC (cellulose gum) is used with considerable success as a thickening agent and stabilizer in rubber latex-based water paints; and to stabilize emulsion paints and lacquer emulsions. Viscosity in resin emulsion paints is easily controlled with CMC, and pigment suspension properties are improved—particularly after the paint has been thinned for application. CMC is also a useful aid in wetting pigments in aqueous pigment dispersions for leather and other products.

Meet This New Film Producer

Hercules has developed a finely powdered metal caseinate which in ammoniacal solution readily forms a metal ammonium casein complex. Upon drying, the complex is broken, and an insoluble metal caseinate film is obtained. This film exhibits excellent water resistance and adhesive properties for pigments to many types of surfaces.

ROSIN AND ROSIN DERIVATIVES · CHLORINATED PRODUCTS · AND OTHER CHEMICAL MATERIALS FOR INDUSTRY

GC50-6



HOW SAFETY-CIRCLE

Means Motor Dependability

EXTRA PROTECTION means extra dependability. That's why Allis-Chalmers protects the working parts of the motor with the exclusive *SAFETY-CIRCLE*. Compare this motor with motors of less rigid construction. The *SAFETY-CIRCLE* motor will not distort in mounting or under strain. And you get the extra protection of drip-proof end brackets at no premium.

EXTRA PROTECTION INSIDE, TOO

Stator is multiple-dipped and multiple-baked in special insulating varnish. Rotor is die-cast aluminum. Stator is mounted in four longitudinal ribs which leaves plenty of air space between stator and frame. Large fans cast integrally with the rotor and ample air intakes keep temperatures well within rated limits. *Ball bearings are factory-lubricated and require no further attention for years.*

When you shop for motors, remember *SAFETY-CIRCLE* gives you *extra protection, extra dependability* and *lower operating costs.*

For details on *SAFETY-CIRCLE* advantages, see your A-C Authorized Dealer or Sales Office or write for Bulletin 51B6210B. Sizes 1 to 20 hp, 326 frames and smaller. *Safety-Circle, Texrope* and *Vari-Pitch* are Allis-Chalmers trademarks. A-3144

Sold . . .
Applied . . .
Serviced . . .

by Allis-Chalmers Authorized Dealers, Certified Service Shops and Sales Offices throughout the country.



CONTROL — Manual, magnetic and combination starters; push button stations and components for complete control systems.



TEXROPE — Belts in all sizes and sections, standard and *Vari-Pitch* sheaves, speed changers.

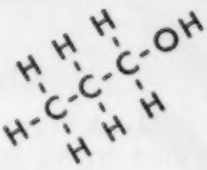


PUMPS — Integral motor and coupled types from ½ in. to 72 in. discharge and up.

ALLIS-CHALMERS, 1147A SO. 70 ST.
MILWAUKEE, WIS.

ALLIS-CHALMERS

CELANESE* n-PROPYL ALCOHOL



lower cost...greater volume

Celanese production of n-propyl alcohol is now meeting large-scale demands. This straight chain alcohol—applicable to processes where its characteristic excellent solvent action and miscibility can be used to advantage—is available for shipment in drum or tank car amounts.

PHYSICAL PROPERTIES

MOLECULAR WEIGHT		60.09
COLOR		water white
ODOR		characteristic alcohol-like odor
SPECIFIC GRAVITY	20°/4° C	0.8036
DISTILLATION RANGE	ASTM °C	2° including true boiling point
WEIGHT PER GALLON	20° C	6.7 lbs.
SOLUBILITY		soluble in water and practically all organic solvents
FLASH POINT	open cup	90° F
BOILING POINT	1 atm.	97.15° C
FREEZING POINT		—127° C
ABSOLUTE VAPOR PRESSURE	20° C	14.5 mm mercury
RELATIVE EVAPORATION RATE		1.3 (butyl acetate=1)

If you are looking for an improvement in your products, or short cuts in processing, the straight chain advantages of n-propyl alcohol are worth investigation. n-Propyl alcohol allows the solvent user greater solvent formulation freedom and can be used as a replacement and extender for higher alcohols. Call or write for additional information and specifications and a copy of the newly published Celanese Chemical Brochure.

CELANESE CORPORATION OF AMERICA,
Chemical Division, Dept. 53-K,
180 Madison Avenue, New York 16, N. Y.

Celanese

U. S. P. FORMALDEHYDE

Formaldehyde, one of the most important products in the growing family of Celanese Organic Chemicals, is now offered in greater volume. This high quality, U.S.P. chemical is sold commercially as Formalin, a water white solution containing 40% formaldehyde by volume, 37% by weight. It is obtainable in both methanol inhibited and uninhibited grades.

Celanese CHEMICALS

*Reg. U. S. Pat. Off.

ALDEHYDES • ALCOHOLS • ACIDS • SOLVENTS • GLYCOLS • KETONES • PLASTICIZERS

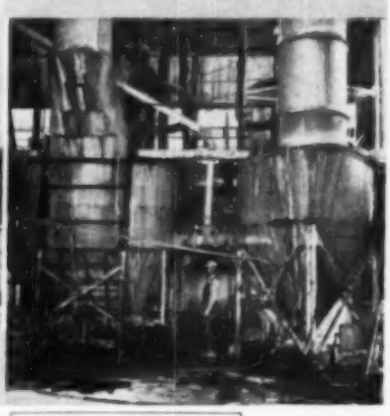
GAS-FIRED SUBMERGED COMBUSTION EVAPORATOR

is production key to Ozark-Mahoning Company's Glauber's Salt Plant



Monahans, Texas, plant of Ozark-Mahoning Company, where Glauber's Salt is produced by the Submerged Combustion Method. Vapor clouds are combustion products of this process.

Two Submerged Combustion Evaporator units in the Monahans plant.

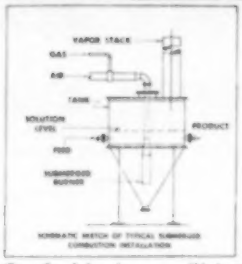


HEAT PROCESSING of Glauber's Salt requires plenty of heat, applied in a variety of ways. To combat former processing difficulties, the Monahans, Texas, plant of Ozark-Mahoning Co., Tulsa, Oklahoma, applies the "Submerged Combustion" principle—burning a Gas flame under water or liquid.

Cooper-Bessemer Gas-burning engines, totaling over 1500 HP, operate process refrigerators which chill natural brine. This brine is filtered, forming a hydrated cake (about 40% Na_2SO_4). The cake is melted and subjected to Submerged Combustion, forming a concentrated slurry which is pumped into settling tanks. Thick bottom slurry is sent to a classifier. Here dilute slurry returns to evaporators, while thickest slurry is completely dehydrated in a GAS-fired rotary kiln.

Air and Gas are burned in the Submerged Combustion chamber, under sufficient pressure to hold out the solution. Burner volume is about 2 cu. ft., in which some 139,000 Btu/min can be released. This heat evaporates large volumes of water which go into the atmosphere as steam.

Gas-fired Submerged Combustion units are extremely versatile. Largest installation to date releases 120,000,000 Btu/hr, can evaporate 1,000 tons of water daily. Products suitable for this GAS-controlled process include: heating and/or evaporation of solutions of sodium sulfate, potassium chloride, phosphoric acid, zinc chloride, waste citrus peel liquors, production of CO_2 and inert gases, etc.



SCHEMATIC SKETCH OF TYPICAL SUBMERGED COMBUSTION INSTALLATION

Here is a Gas-fired business, utilizing the productive flames of GAS from beginning to end. GAS is always ready to serve you in unusual processes like Ozark-Mahoning's, because of its ready adaptability, accuracy of control, and efficiency. Your Gas Company Representative has the facts, and you'll get the answers if you call him today.

MORE AND MORE... THE TREND IS TO GAS FOR ALL INDUSTRIAL HEATING

AMERICAN GAS ASSOCIATION

420 Lexington Avenue, New York 17, New York

ONLY THE BEST IN DUST FILTERS

can be used for radioactive dust recovery



(Illustration shows unhoused unit)

FILTERS WITH HERSEY REVERSE-JET PRINCIPLE SHOW UP TO 99.998% EFFICIENCY IN ACTUAL TEST*

Dust filters used on radioactive dust must meet exacting and unusual requirements over and above normal applications. Such requirements are:

1. High cleaning efficiency of 99.99% or better. Radioactive dusts are valuable and of such a nature that they cannot be allowed to pollute the atmosphere.

2. Minimum maintenance and ease of access. The nature of radioactive dust limits the time a man may spend servicing the filter.

3. Minimum handling of collected dust. Dust contaminated with radioactivity requires careful handling and disposal.

According to reports of actual tests conducted by a user not affiliated with The Day Company, the type of filter which best meets these requirements is based on the Hersey reverse-jet principle.

The dust loads were from 0.07 to 32 grains per cubic foot, at air-to-cloth ratios of 16 to 27 cfm per square foot, and with pressure drops of 3.5 inches to 6.5 inches water gauge.

Under these conditions, *collection efficiencies ranged from 99.95% to 99.998%.*

WHAT THIS MEANS TO YOU

Because the DAY "Type AC" Dust Filter meets the rigid requirements in handling radioactive dust, it is the best filter to handle the dust filtering problems in *your* plant. Its high cloth cleaning efficiency and minimum maintenance requirements are also important factors to *your* dust control operation. The reverse air jet cleaning mechanism affords continuous-automatic operation with constant air volumes and eliminates cleaning shutdowns. Its gentle, yet positive continuous cleaning action, permits the use of high grade felt filtering fabric which collects even the finest dust particles. This high grade filtering cloth also allows greater air-to-cloth ratios.

The DAY "Type AC" filter is your best buy in dust filters. With no cleaning shutdowns, you save money because you need less filter to handle equal volumes of air. This means less floor space. Simple, rugged construction gives years of dependable operation with minimum, low cost maintenance.

Write-to-DAY for Bulletin Number 491.

*Conducted by a large dust filter user. Name furnished on request.

DOUBLE CHECK THESE IMPORTANT ADVANTAGES OF THE DAY "TYPE AC" DUST FILTER

- √√ *Continuous-Automatic Operation*
- √√ *Constant Air Volumes*
- √√ *High Cloth Cleaning Efficiency*
- √√ *High Air-to-Cloth Ratios*
- √√ *Parallel Air Flow*
- √√ *Separated Dust Streams*
- √√ *Over-all Economy*

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Our 42 years' experience in specialized transportation service, and in solving all types of shipper problems, is yours when you ship via North American. Our friendly experts will welcome you at any of the offices listed below.

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DEMPSTER DUMPSTER SYSTEM

SERVING COST-MINDED MANAGEMENT FROM COAST TO COAST

. . . handling bulk materials of every description at phenomenal savings







Photos show the three simple stages of servicing a container. The Dempster-Dumpster, operated from hydraulic controls by driver in the cab, picks up each container and hauls it to point of disposition where it may be dumped or set down intact.

GULF – *recognized across the nation*

. . . Gulf Oil Corporation, well known for sound management, uses the Dempster-Dumpster System

Gulf Oil Corporation is among the hundreds of well managed manufacturers, both large and small, who use the Dempster-Dumpster System of bulk materials handling . . . the system recognized across the nation for its efficiency and ability to reduce costs.

There is never an idle moment for a truck mounted Dempster-Dumpster around a manufacturing plant. With a variety of Dempster-Dumpster containers spotted inside and outside your plant, one Dempster-Dumpster, with only one man, the driver, is kept busy servicing one pre-loaded container after another. These detachable containers, ranging in size up to 12 cu. yds., carry pay-loads equal to conventional truck bodies. They are built in a wide variety of designs best suited to the type of materials handled—be they bulky, light or heavy . . . solids or liquids . . . trash or rubbish.

In addition to amazing increases in man-power efficiency . . . greatly reduced investment, and maintenance costs, the Dempster-Dumpster System improves "housekeeping" methods . . . reduces fire hazards . . . provides an easier, quicker, safer and more efficient manner of handling materials. It will pay you to investigate the Dempster-Dumpster System now! A product of Dempster Brothers, Inc.

One Dempster-Dumpster Services All Containers. . . All Designs. . . All Sizes



DEMPSTER BROTHERS, 2110 DEMPSTER BLDG., KNOXVILLE, 17, TENN.



No. 47 **Boiler Water Feeder** — for hand-fired steam heating boilers up to 5000 sq. ft.



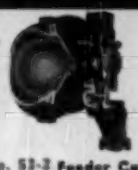
No. 47-2 **Feeder - Cut - off Combination** for automatically fired steam heating boilers up to 5000 sq. ft.



No. 147 **Boiler Water Feeder** — Similar to No. 47, but with higher feeding level for process steam boilers.



No. 247 — Same as No. 47, but for installation with 1" equalizing pipes.



No. 51-2 **Feeder Cut-off Combination** — Similar to No. 51-2, but built for higher pressure, up to 75 lbs..



No. 51 **Boiler Water Feeder** — for hand fired steam heating boilers over 5000 sq. ft.



No. 51-2 **Feeder - Cut - off Combination** — for automatically fired steam heating boilers over 5000 sq. ft.



No. 67 **Low Water Fuel Cut-off** — for low pressure steam boilers of any size.



No. 150 **High Pressure Pump Control, Cut-off and Alarm** — for steam boilers of any size up to 150 lbs. pressure.



No. 157 **Water Column Type High Pressure Pump Control, Cut-off and Alarm** — for steam boilers of any size up to 150 lbs. pressure.

You should know ALL of these McDONNELL PRODUCTS



No. 101 **Electric Water Feeder** — operated by No. 67 or liquid level switches.

• You are probably familiar with the more commonly used McDonnell Products. But for those jobs you may run across from time to time that call for special equipment, you should be familiar with *all* the McDonnell liquid level controls, flow switches, and similar products listed here. They are all evidence of how intensively McDonnell has worked at "DOING ONE THING WELL." We will be glad to give you information and counsel on any special application that may arise.

McDONNELL & MILLER, INC., 3500 N. Spaulding Ave., Chicago 18, Ill.

Doing One Thing Well



No. 33 **Safety Relief Valve** — for hot water heating boilers. Btu rated. ASME standard.



No. E-2 **Flow Switch** — Completes (or breaks) circuit when flow starts or stops.



No. 21



No. 121



No. 321



No. 421

Make-up Water Feeders—to maintain adequate water supply in receiving tanks. Nos. 21, 121 and 321 are installed right in tank openings; available in various flange forms and sizes as shown to fit existing openings. No. 421 is for external application, with equalizing piping.



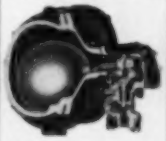
No. L-8 **Constant Level Valve** — Maintains constant fuel oil pressure on burner.



No. 417 **Snap Action Water Valve** — Maintains water level in humidifier pans and in tanks.



No. 517 **Water Level Control** — Same as No. 417, but in die cast float chamber with cover.



No. 355 **Large Capacity Float Valve** — Has many uses on tanks, stills, receivers, etc.



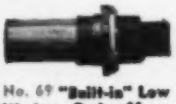
No. 61 **Low Water Fuel Cut-Off** — for 1" equalizing pipe installation on low pressure steam boilers.



No. 63 **Low Water Fuel Cut-off** — for water or steam boilers up to 50 lbs. pressure.



No. 65 **Explosion-proof Electric Controller** — Underwriters' approved for hazardous locations.



No. 69 **"Built-in" Low Water Cut-off** — Typical of many "built-ins" for installation in tappings provided in modern boilers.



No. 469 **"Built-in" Low Water Cut-off** — Similar to No. 69, but with less projection into boiler.



No. 767 **Low Water Fuel Cut-off** — (with No. 14 blow-off) for easy installation into opening in boiler.



No. 80 **Switch** — Three wire high- or low-level alarm or pump control on oil storage tanks.

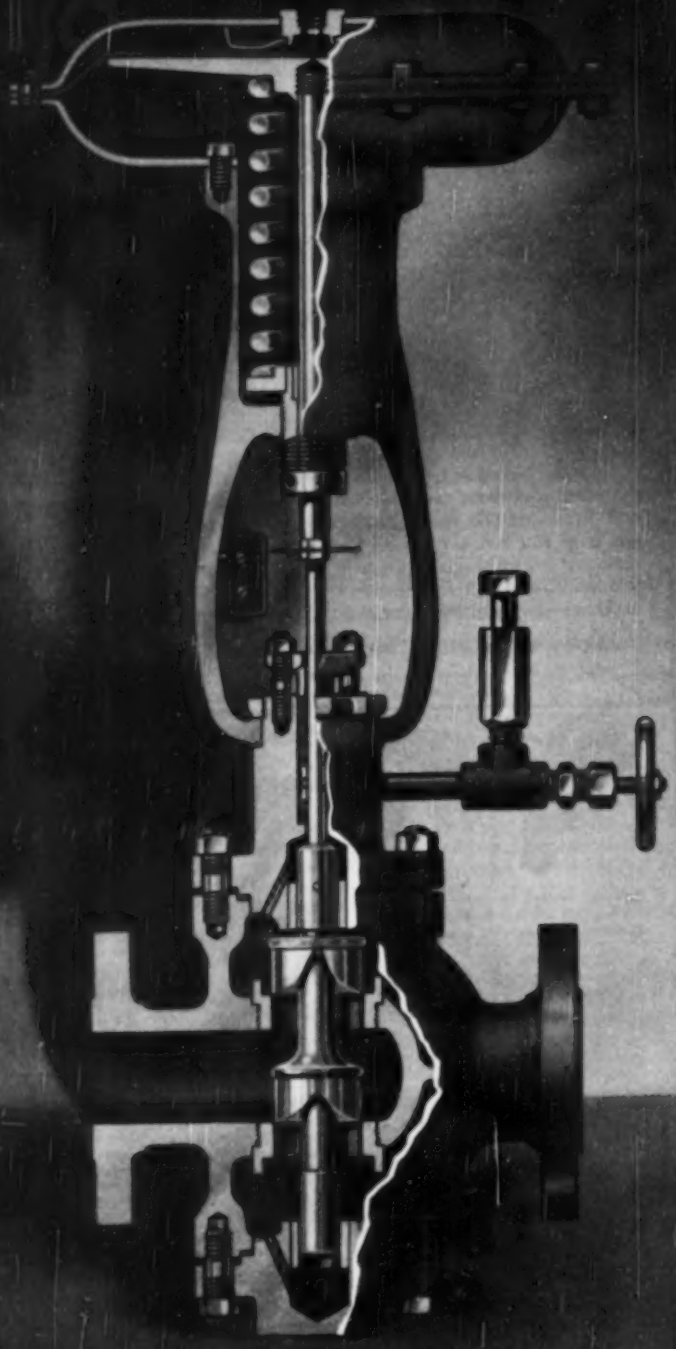


No. 6667 **Conversion Head** — for converting former cut-offs into two-switch types.



No. 154 **High Pressure Pump Control** — Similar to No. 150, but with open contact switches.

Attention to Detail



In design and manufacture pays off in

MASONEILAN
Air Operated
CONTROL VALVE
PERFORMANCE

The new Masoneilan Control Valves are outstanding examples of the results obtained by thorough attention to design details and exacting standards in manufacture.

In design they represent endless studies, untiring laboratory testing and the accumulated experience gained in actual field service for over half a century — the know-how which enables Masoneilan specialists in valve design to attain the optimum compromise between the ideal and the practical, consistent with the end use.

In manufacture they are the product of the most modern precision manufacturing equipment, the best known methods and skills of experienced operators, constantly checked during and after processing and assembly by rigid inspection standards, with specially designed gauging equipment.

The result is a valve which gives you the performance that you have a right to expect.

We invite your detailed inspection — note the care taken to insure stem, seat rings, plug, bonnet and blindhead alignment, the responsive and powerful diaphragm motor, resistance to corrosion, adequate lubrication. Note, also, the *extras* which provide so much practical usefulness — the indicator plate graduated in ½-inches actual travel; the serial plate which gives you *full* valve specifications, the external adjusting screw for setting spring initial; the yoke detachable without disturbing bolted stuffing box; the open structure providing ample room for servicing stuffing box and attaching positioner take-off linkage; the two integral mounting pads for controller or positioner and air regulator-filter dripwell.

Practical engineers will appreciate Mason-Neilan's realistic approach to the control valve problem — and Mason-Neilan's latest answer. May we send you our new bulletin?

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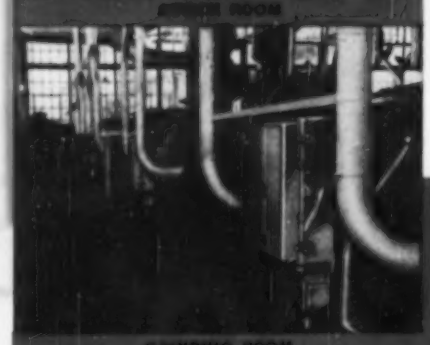
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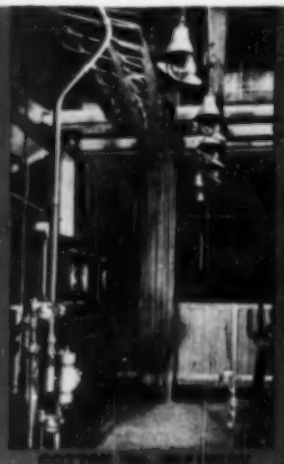
CONDULETS* and rigid conduit

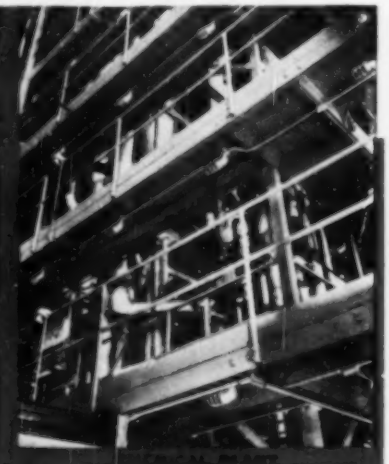












YOU can install galvanized CONDULETS and galvanized rigid conduit under all atmospheric conditions and in all occupancies

(See Article 346, Section 3462, National Electrical Code.)

The **CONDULET** and rigid conduit method meets the requirements of the National Electrical Code in locations exposed to weather, heat, moisture, steam, vapor, dust and dirt or locations that are hazardous because of the possibility of the presence of flammable gases or vapors, or combustible dusts. The same sterling qualities that make **CONDULETS** the first choice in these special applications, make them first choice in **ALL** ordinary locations.

**CONDULET is a coined word registered in the U. S. Patent Office. It designates a product made only by the Crouse-Hinds Company.*

. . . . the UNIVERSAL wiring method

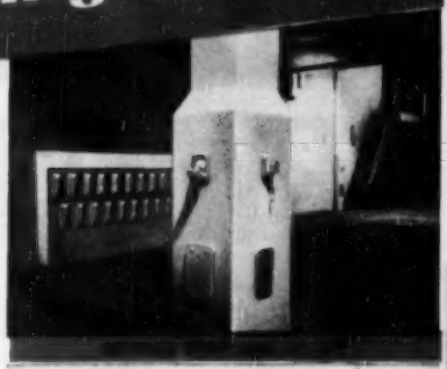
"for MODERN WIRING . . .

the CONDULET and conduit method

gives you definite advantages"

1. **MECHANICAL PROTECTION . . .** Rigid conduit and cast Feraloy CONDULETS provide the best possible protection against accidental damage to the wiring and equipment. Prevents costly shutdowns.
2. **SAFETY . . .** A CONDULET installation gives maximum protection against personal injury and fire. The continuous conduit system made up with taper threaded CONDULETS provides a reliable and permanent low resistance path to ground.
3. **FLEXIBILITY . . .** To meet all the diverse requirements of modern electrical layouts, CONDULETS are made in a wide variety of shapes and sizes with varied hub arrangements, including a full line of CONDULETS with detachable hub plates.
4. **ECONOMY . . .** The installed cost compares favorably with other methods, while the total cost over the years is definitely lower, due to the durability, reliability, safety, and low maintenance cost of a CONDULET and rigid conduit system.
5. **CORROSION RESISTING . . .** Galvanized cast Feraloy CONDULETS offer the best protection wherever moisture, dust or corrosive atmospheres are present.
6. **QUALITY . . .** The trademark CONDULET stands for reliability and long life. Every CONDULET is built to Crouse-Hinds high standard of quality with painstaking care by skilled craftsmen.

On **YOUR** next electrical layout, for any location, plan to get all the benefits of sturdy cast Feraloy CONDULETS and rigid conduit . . . the UNIVERSAL wiring method. More than 15000 types and sizes are listed in the CONDULET Catalog.









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NEW CHEMICALS

More than a score of new products have been added to the ever-growing family of Monsanto Chemicals. Many of these Monsanto additions already have well-established applications in *serving industry . . . which serves mankind*. There are, no doubt, many more applications yet undiscovered. Among the new Monsanto Chemicals listed on these pages may be some that can help you improve products, lower production costs or develop something entirely new for your market. Look over the descriptions, and, if you see such possibilities, mail the coupon for information.

Colloidal Aluminum Phosphate "D"

Suggested Use: To confer high "green strength" and good high-temperature bonding to heavy-duty refractures and other ceramics; to substitute for sodium silicates, particularly where the alkalinity of silicates is undesirable.

Properties: A glassy, thermoplastic, colloidal aluminum phosphate milled with ceramic-grade clay as a parting agent. It is a free-flowing tan powder having a packed density of 0.9. Typical analysis: P_2O_5, 37.2%; Al_2O_3, 22.2%; SiO_2, 10%; ignition loss, 30%; particle size, essentially all through 100 mesh.

Availability: Commercial quantities. (P-1)

2-Bromothiophene (alpha-Bromothiophene)

C_4H_3SBr M. W. 163.0

Suggested Use: Intermediate in chemical synthesis.

Properties: Colorless, oily liquid. Slowly darkens on standing. Miscible in alcohol, ether and other organic solvents. Immiscible in water. B.P. about 150° C.; Sp. Gr. 1.706 at −25°/25° C.; Refr. Ind. 1.584 at 25° C.

Availability: Pilot plant quantities. (O-2)

4-Chloro-2-Methylphenoxyacetic Acid

$CH_3ClC_6H_3OCH_2COOH$ M. W. 200.5

Suggested Use: Selective herbicide.

Properties: A technical product. Tan powder. Soluble in alcohol, benzene and acetone; sparingly soluble in water.

Availability: Pilot plant quantities. (O-3)

Diisobutenyl Succinic Anhydride

$C_4H_7CH(CO)OC(O)CH_2$ M. W. 210.3

Suggested Use: Intermediate in alkyd resins, surface-active agents, plasticizers and other fields.

Properties: A colorless to pale-yellow viscous liquid. Soluble in acetone and benzene, reacts with alcohol to form esters, insoluble in water and decomposes slowly to the acid. B.P. about 120-130° C. at 1 mm.; Sp. Gr. 1.04 at 25°/25° C.

Availability: Pilot plant quantities. (O-4)

2-(2-Dimethylaminoethylamino)-pyridine

$(CH_3)_2NCH_2CH_2NHC_5H_4N$ M. W. 165.2

Suggested Use: In the preparation of antihistaminics and other pharmaceuticals.

Properties: Yellow to brown, clear liquid. Miscible with water, alcohol, and benzene. B.P. about 265° C.; Sp. Gr. 0.99 at 25°/25° C.

Availability: Commercial quantities. (O-5)

Dimethyl Fumarate

$CH_3OOCCHCHCOOCH_3$ M. W. 144.1

Suggested Use: Copolymer in polyester resins.

Properties: White powder. Soluble in alcohol, insoluble in water. M.P. 102° C. B.P. 192° C.

Availability: Semicommercial quantities. (O-6)

Dimethyl p-Nitrophenyl Thionophosphate

$(CH_3O)_2P(S)OC_6H_4NO_2$ M. W. 263.2

Suggested Use: For the preparation of insecticidal and miticidal sprays and dusts.

Properties: Light-amber crystalline compound. Miscible with alcohol, acetone and benzene; immiscible with water. Cr. Pt. 25° to 30° C. Refr. Ind. 1.55 at 40° C. Sp. Gr. 1.39 at 25°/25° C.

Availability: Pilot plant quantities. (O-7)

2,4-Dinitrophenyl Thiocyanate

$(NO_2)_2C_6H_3SCN$ M. W. 225.1

Suggested Uses: Plant fungicide; short-stop in polymerization of synthetic rubber and intermediate.

Properties: Golden-yellow crystalline powder. Slightly soluble in alcohol, soluble in benzene and acetone, insoluble in water. M. P. about 135° to 140° C.

Availability: Semicommercial quantities. (O-8)

o-Ethylaniline (o-aminoethylbenzene)

$CH_3CH_2C_6H_4NH_2$ M. W. 121.2

Suggested Use: Chemical intermediate in dyestuff, rubber and other fields.

Properties: Yellow liquid. Like aniline, it turns red on long standing. Miscible in alcohol and benzene, slightly miscible in water. B. P. about 215° C. Refr. Ind. 1.56 at 25° C. Sp. Gr. 0.980 at 25°/25° C.

Availability: Semicommercial quantities. (O-9)

o-Ethylnitrobenzene

$C_2H_5C_6H_4NO_2$ M. W. 151.1

Suggested Use: Intermediate in dyestuff, pharmaceuticals and other fields.

Properties: Yellow to green clear liquid. Miscible in most organic solvents, immiscible in water. Cr. Pt. about −12° to −14° C. Sp. Gr. 1.1 at 25°/25° C. Refr. Ind. 1.53 at 25° C. B.P. about 228° C.

Availability: Commercial quantities. (O-10)

Fluid F-9 (Nonflammable Hydraulic Fluid)

Suggested Use: In industrial hydraulic applications where low cost, nonflammability and high lubricity are desired.

Properties: Clear, light-yellow liquid. Sp. Gr. 1.27 at 25°/25° C. Pour point about 5° F. V.I. above 15. Viscosity at 210° F., 5.5 to 6.0 centistokes. Autogeneous ignition point above 1100° F.

Availability: Commercial quantities. (O-11)

p-Formylacetanilide

$CH_3C(O)NHC_6H_4CHO$ M. W. 163.2

Suggested Use: Intermediate in pharmaceutical and other fields.

Properties: Light-yellow crystalline powder. Soluble in water (10% at boiling), soluble in alcohol and acetone. M.P. about 155° C.

Availability: Semicommercial quantities. (O-12)

p-Formylacetanilide Thiosemicarbazone

$CH_3C(O)NHC_6H_4CHNNHC(S)NH_2$ M. W. 236.3

Suggested Use: In antitubercular therapy.

Properties: White to yellow-white crystalline powder. Slightly soluble in alcohol and acetone, very slightly soluble in water. M.P., decomposes about 225° C.

Availability: Commercial quantities. (O-13)

Hydraulic Fluid OS-16 (Flame-resistant Hydraulic Fluid)

Suggested Use: As an industrial hydraulic fluid in critical applications where lack of toxicity and nonflammability are required over a wide range of operating temperatures.

Properties: Clear, light-blue, mobile liquid. Sp. Gr. 1.09 at 25° C. Viscosity 11.05 centistokes at 100° F. and 2.65 at 210° F. Viscosity index 76. Pour point −70° F.

Availability: Commercial quantities. (O-14)

Methyl p-Toluenesulfonate

$CH_3C_6H_4SO_2CH_3$ M. W. 186.2

Suggested Use: As a selective methylating agent.

Properties: White to light-yellow liquid or crystals. Soluble in alcohol and benzene, insoluble in water. Sp. Gr. 1.23 at 25°/25° C. Cr. Pt. 26° to 27° C.

Availability: Commercial quantities. (O-15)

p, p′ Diisocyanatodiphenylmethane

p,p′-$OCNC_6H_4CH_2C_6H_4NCO$ M. W. 250

Suggested Uses: As a cross-linking agent for polymers; as an ingredient for foamed resins and in adhesives, and in the preparation of copolymers.

Properties: Pale-yellow solid. Insoluble in water, soluble in benzene. Freezing point about 37° C. Boiling point 194-199° C., (5 mm.). Sp. Gr. 1.185 at 50° C.

Availability: Semicommercial quantities. (P-16)

Phenyl 2-Thienyl Ketone (Benzoylthiophene)

$C_6H_5COC_4H_3S$ M. W. 188.1

Suggested Use: As a chemical intermediate particularly in pharmaceuticals.

Properties: Yellow or green lumps. Soluble in alcohol, acetone and benzene; insoluble in water. Cr. Pt. 52° C.

Availability: Commercial quantities. (O-17)

Phosphorous Acid 70%

H_3PO_3 M. W. 82.04

Suggested Uses: As a strong, though sometimes slow, reducing agent; as an intermediate in the manufacture of phosphite salts. (Disodium phosphite, monosodium phosphite; sodium hemaphosphite.)

Properties: A white crystalline solid. M.P., 73° C. Furnished as a water-white 70% clear solution of phosphorous acid in water. Sp. Gr., 1.420 at 25° C. Thermal change in Sp. Gr., 0.0007/4 per degree C. from 10 to 60° C. Electrical conductivity, approx. 0.15 reciprocal ohms at 25° C. B.P. of 70% solution, 125° C. at 760 mm. Solution loses water up to approx. 235° C., and decomposes at that temperature to PH_3 and H_3PO_4. Solution becomes saturated at −20° C., and freezes solid at approx. −50° C. Ref. Ind. of supercooled 100% H_3PO_3, 1.4420 at 30° C. Phosphorous Acid is a strong dibasic acid. Ionization constants at concentration of 0.05 mols./l. at 18° C. are $K_1 = 5.4 \times 10^{-2}$, $K_2 = 2.1 \times 10^{-7}$.

Availability: Commercial quantities. (P-18)

KZ-50

$(C_4H_9)_2NC(S)SNH(C_6H_{11})(CH_3)$ M. W. 332

Suggested Use: As an ultra-accelerator for vulcanizing rubber cements.

Properties: 50% solution of N,N-dimethyl cyclohexyl ammonium dibutyl dithiocarbamate in "cellosolve." Clear brown liquid; color (N.P.A.), 8.0 max. Sp. Gr. at 25° C., 0.964.

Availability: Commercial quantities. (O-19)

Santoflex® AW

$C_{15}H_{17}NO$ M. W. 227.3

Suggested Use: As an antiweathering agent and antioxidant for natural and synthetic rubbers.

Properties: Condensation product p-phenetidine and acetone, primarily 6-ethoxy-2,2,4-trimethyl-1,2-dihydroquinoline. Dark, viscous liquid. Sp. Gr. at 45° C. 1.030-1.040. Flash point (C.O.C.), 250° F. min. Soluble in benzene, toluene, acetone, methanol, diethyl ether.

Availability: Commercial quantities. (O-20)

Santolene® C Rust Inhibitor for light petroleum products

Suggested Use: Particularly suitable for inhibiting rust in lines and vessels used for transportation and storage of gasoline, kerosene and fuel oil.

Availability: Commercial quantities. (O-21)

Santolube® 374

Suggested Use: As additive in formulation of heavy-duty motor oils. Imparts detergent-dispersant and corrosion inhibition properties. Also acts as pour point depressant.

Availability: Commercial quantities. (O-22)

Santopoid® 32 All-Purpose Oil Additive

Suggested Use: Recommended for formulation of gear lubricants suitable for automotive equipment operated under conditions of high speed and heavy loads.

Availability: Commercial quantities. (O-23)

Santowhite® L (Diamyl phenol sulfide)

$(C_5H_{11})_2C_6H_2(OH)S$ M. W. 499

Suggested Use: As a nondiscoloring antioxidant for foamed latex sponge and other rubber stocks.

Properties: Dark, viscous syrup. Phenolic odor. Softening point 0° C. Sp. Gr. at 25° C. 0.99. Soluble in benzene, toluene, acetone, diethyl ether; insoluble in water but can be emulsified easily.

Availability: Commercial quantities. (O-24)

2-Thiophenecarboxaldehyde (Thiophene-2-aldehyde)

C_5H_4SCHO M. W. 112.1

Suggested Use: As a chemical intermediate in pharmaceutical and other fields.

Properties: Colorless liquid that darkens on standing. Miscible in benzene and alcohol, immiscible in water. Cr. Pt. −6° to −8° C. B.P. 90° to 95° C. at 25 mm. Sp. Gr. 1.2 at 25° C. Refr. Ind. 1.585 at 25° C.

Availability: Commercial quantities. (O-25)

Veratrole (o-Dimethoxybenzene)

$C_6H_4(OCH_3)_2$ M. W. 138.2

Suggested Uses: As an intermediate in chemical synthesis; as a solvent.

Properties: Colorless to pale-yellow liquid. Soluble in most organic solvents, very slightly soluble in water. M.P. 22.5° C. B.P. 207° C. Sp. Gr. 1.08 at 25°/25° C.

Availability: Commercial quantities. (O-26)

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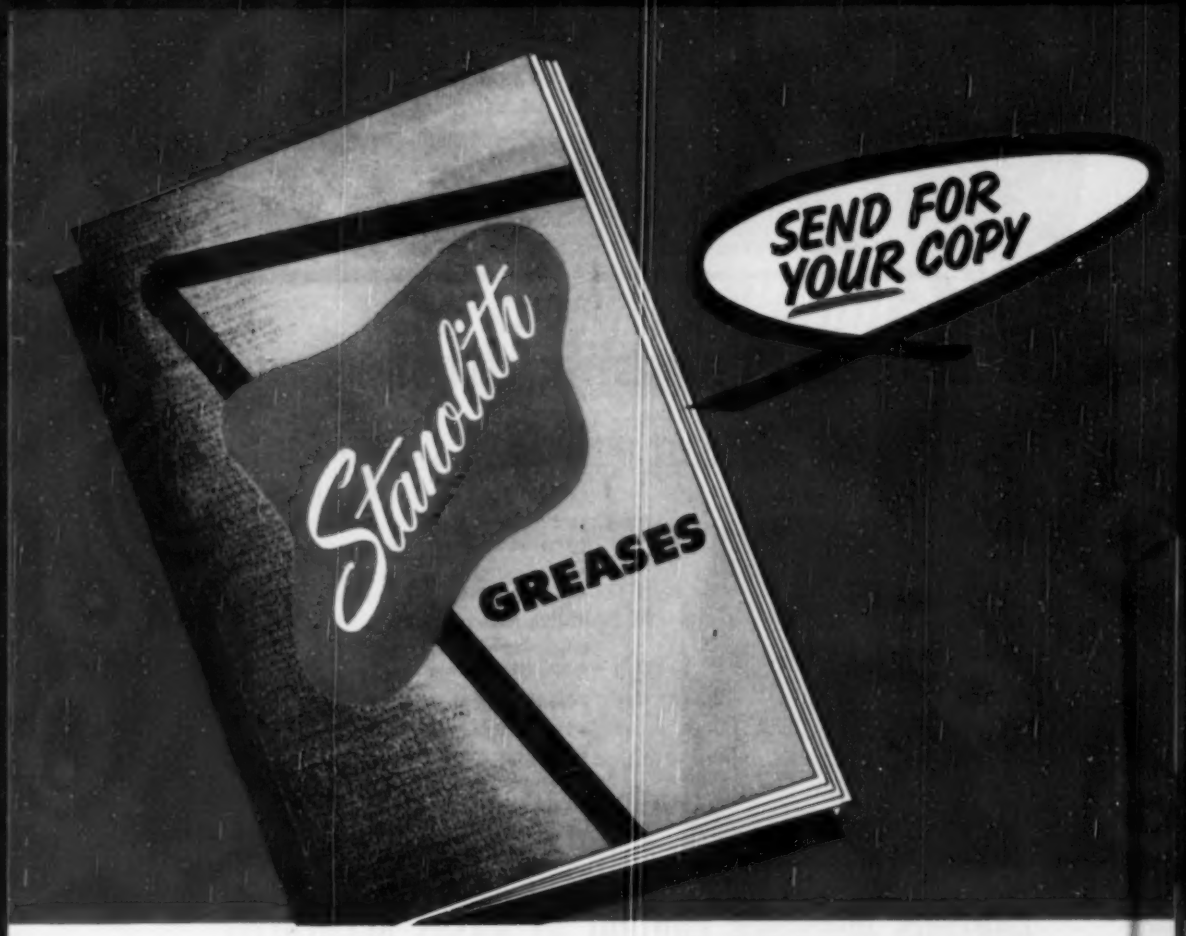
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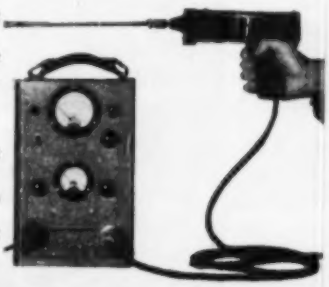
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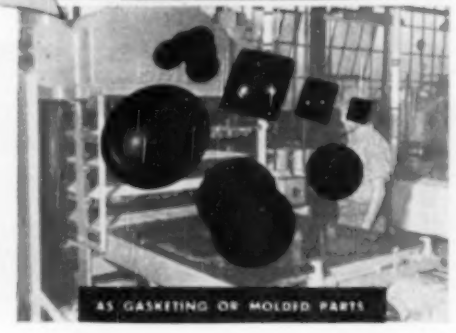
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COMMENTS ON THE NEWS OF CHEMICAL ENGINEERING IN INDUSTRY

Prepared under the editorial direction of Joseph A. O'Connor, News Editor

Coming up, more chlorine and sodium

National Distillers Chemical Corp. plans to shell out between $300,000 and $400,000 immediately to step up production at its new $10 million plant in Ashtabula, Ohio. A second chlorine liquefaction unit is to be added. Right now, chlorine is in tight supply.

Original timetable for starting up the plant called for operation at 50 percent of capacity by this time. Actually, the plant is running at 85 percent of capacity now. Estimated daily capacity of the huge plant—when all its 94 Downs cells are operating—is 100,000 lb. of sodium and 154,000 lb. of chlorine.

With improved manufacturing methods and increased uses during the past 60 years, the price of sodium has dropped from $2 per lb. to less than 20 c. per lb. Production of sodium by the Castner process attained a peak of 15,000 tons per year in the middle 1920's, just prior to the use of sodium in the manufacture of tetraethyl lead. The nation's annual sodium requirements currently exceed 75,000 tons.

When the present expansion is completed, National Distillers plans to start making sodium peroxide at Ashtabula.

For U. S. Rubber, greater vinyl capacity

Watch for a big expansion of vinyl resin capacity by U. S. Rubber at Painesville, Ohio. The operation will be carried out in two phases. Its objective: to double the size of the present plant.

First phase, already under way, will bring the plant up to its designed production level. Glenn L. Martin Co., original owner of the vinyl plant at Painesville, designed it for a capacity production of 25 million pounds per year. When U. S. Rubber took it over, the plant was equipped to produce only about half that amount. Today, production is about 14 million pounds per year. To bring the plant up to designed capacity, new machines are currently either being installed or are on order. This program is going to take four or five more months.

Second phase, to be embarked upon as soon as the current expansion is completed, will double the size of the present plant. And when that is done, U. S. Rubber might even install its own chlorine plant, since Diamond Alkali has notified U. S. Rubber that it's in no position to supply any one customer with the amount of chlorine that the vinyl plant will then need. U. S. Rubber's vinyl plant, incidentally, is only slowly getting back into normal operation after the long strike at the Diamond plant, a major source of raw materials for U. S. Rubber.

Built in 1947 at a cost of $6 million, the Painesville plant consists of nine buildings and is the third largest vinyl plastics plant in the country. U. S. Rubber acquired it when it purchased Glenn L. Martin's chemical division in a deal that reportedly involved between $6 million and $7 million.

Vinyl plastics have come into widespread use since World War II. Consumption in the United States at present is estimated in excess of 200 million pounds a year.

Synthetic rubber size-up

GOAL—First of the government's big GR-S copolymer plants, the one that U. S. Rubber operates at Port Neches, Tex., is back in operation (see p. 211). And that's only the beginning. With consumption of rubber—both natural and synthetic—running at an all-time record high of 1,200,000 long tons a year, goal of the government is to open all available plants and put them to running wide open. Production was first stepped up when the soaring price of natural rubber made GR-S economically more attractive.

START—First move in July was to order the reopening of mothballed units at Port Neches and Baton Rouge that could add 72,000 long tons of GR-S and 13,000 tons of butyl to annual capacity. These plants, when in production, bring total potential output in operation to 500,000 tons of GR-S and 75,000 tons of butyl—practically all of the butyl capacity there is.

ALL OUT—Then, as the Korean situation dawned, all the stops were opened wide—and all remaining mothballed plants likewise—including the alcohol butadiene plants and the copolymer plants designed to use their output. If and when all these government plants get going, and assuming they get the raw materials needed, then you'll have enough operating capacity to produce about 760,000 tons per

(Continued on page 69)

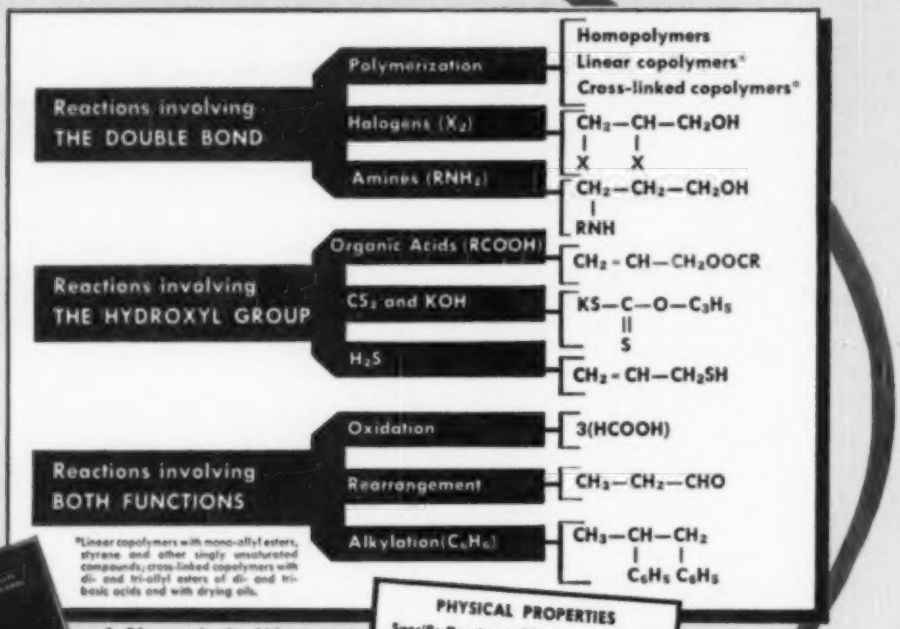
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year of GR-S and 75,000 tons of butyl. In addition, private producers have capacity to turn out 5,000 tons of S-types, 60,000 tons of neoprene and 20,000 tons of N-type rubber.

ALCOHOL BUTADIENE UNITS—When all the copolymer plants are running, perhaps by early next year, they'll be making 760,000 long tons of GR-S a year. Of this, 160,000 tons will be running on butadiene from alcohol. The plants running on butadiene from alcohol are at Kobuta, Pa., and Louisville, Ky. Butadiene units at these same locations have the capacity to produce all the butadiene these copolymer plants can consume.

PETROLEUM BUTADIENE—The 600,000 tons of GR-S capacity based on butadiene from petroleum represents the maximum output of the petroleum butadiene plants. This GR-S production will gobble up between 950,000,000 and 1,000,000,000 lb. of butadiene. If more butadiene becomes available, copolymer output can be shoved up by technical gimmicks. At the refineries, there'll be enough alkylates for high-priority aviation gasoline, but cuts in octane rating for civilian gasoline are likely.

STYRENE NEEDS—The GR-S plants will need about 195,000 short tons of styrene, roughly two-thirds of annual U. S. capacity. This spells cutbacks in styrene for plastics. And it will take some 47,000,000 gal. of already tight benzene to make this styrene.

ALCOHOL—The 160,000 tons of GR-S from alcohol butadiene means consumption of 135,000,000 to 150,000,000 gal. of alcohol a year. Office of Rubber Reserve expects to be in the market for between 4,000,000 and 5,000,000 gal. of industrial alcohol this month and 6,000,000 to 7,000,000 gal. in December. "We expect to buy this alcohol from any source we can," a Rubber Reserve spokesman says. ORR is negotiating with U.S. distillers and is also after French alcohol.

IMPORTS FROM FRANCE—Report is that ORR has bought 11,000,000 gal. of alcohol from France, reportedly at 43 c. a gal., which seems low. The French are supposed to have 50,000,000 gal. more on the block. And they say they can guarantee 125,000,000 gal. next year if the price is right.

Odds are that ORR will get, say, 50,000,000 gal. abroad and 100,000,000 gal. from U.S. distillers. Maximum alcohol output of distillers is estimated at 225,000,000 gal. per year.

CLIMBING COSTS—As to cost of making GR-S from alcohol butadiene, everything depends, of course, on the price of the alcohol. Anyway, it's safe to say that butadiene from alcohol will now cost at least two or three times what it costs to make it from petroleum. Cost of GR-S, as an upshot, would probably come out at 20 to 25 c. per lb.

Also, from here on out, ORR is bringing in less efficient plants, less well located—which means more cost over and above the higher cost of butadiene from alcohol. What's more, there's going to be more crosshauling of butadiene and other feedstocks, which likewise runs costs up.

On that score, ORR tank car requirements will be greater; estimates of needs are being made now. This will be an extra demand for already scarce chemical tank cars.

New departure in coating resins

A brand new series of resins for surface coatings is revealed this month by Shell Chemical. They exhibit outstanding adhesion, flexibility and chemical resistance. The resins are made from an entirely new family of raw materials: epichlorhydrin, acetone and phenol. Shell's new plant for their production starts operating this month at Houston, Tex.

These EPON resins constitute a new class of condensation polymer with ether linkages between carbons and relatively wide distances between functional groups. Actually, they're resinous polyhydric alcohols. The polar nature of the molecule makes possible the outstanding adhesion. Wide spacing along the chain of the reactive hydroxyl and epoxide groups gives rise to the unusual flexibility of the cured resin. And it's the ether linkage that imparts the chemical resistance.

Shell Chemical and Devoe & Raynolds put years of joint effort into the development of these new resins. While their initial cost may be somewhat higher, these resins are competitive in their applications with alkyds (for more details, turn to p. 192).

Ammonia plant in Pacific Northwest?

WHO'LL BE FIRST?—More than one chemical company is shrewdly sizing up the possibility of an ammonia plant somewhere in the Pacific Northwest. As yet, no company has decided to build one, however. And chemical executives are keeping any such ideas under their hats. For the present and potential market for ammonia in the Pacific Northwest is not large, and the first company to build an ammonia plant will get the jump on its competitors.

WHY WAIT?—Why are the companies moving slowly in deciding to build ammonia plants in the region? There are two major reasons.

NOT ENOUGH GAS—One reason, of course, is the present inadequate supply of natural gas, which would be a source of hydrogen. It seems unlikely that Canadian natural gas can be supplied to the U. S. Northwest within the next year, both because of the current steel shortage and because Canadian government authorities have been so slow in granting a license to any of the competing companies in Canada to build a gas pipeline from Alberta. Until some Canadian outfit gets the right to build a pipeline and has decided the length and capacity of the line, the important

(*Continued on page 72*)

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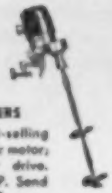
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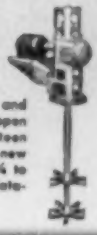


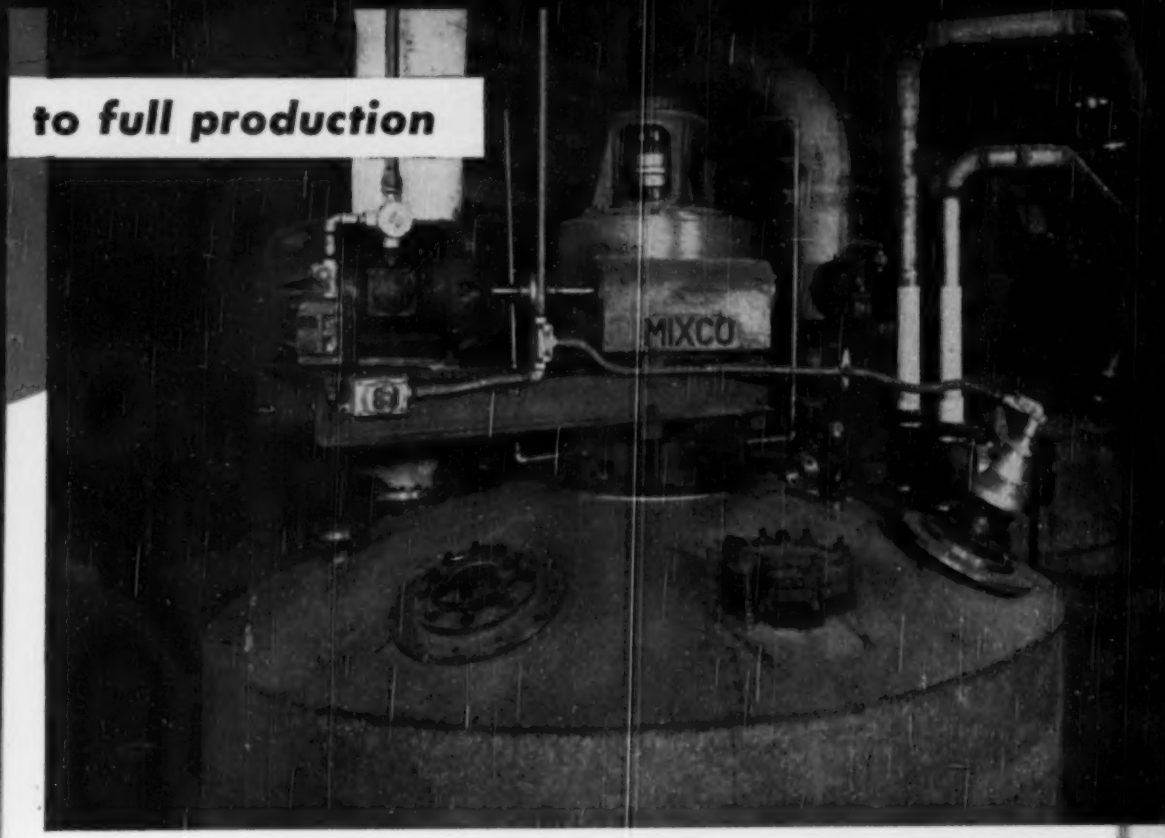
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question of the delivered price of natural gas at any specific locality in the Pacific Northwest must remain uncertain.

AMMONIA PULPING UNPROVED—Another reason for the uncertainty in the ammonia situation is that paper companies are still awaiting conclusive results on the experimental ammonia pulping process being investigated by Crown Zellerbach at Lebanon, Ore., and the experimental magnesia pulping process under study on a large scale by Weyerhaeuser at Longview, Wash. Not all of Crown Zellerbach's equipment is installed yet, but it will be soon.

Both Crown Zellerbach and Weyerhaeuser are quite cautious and conservative in making any claims for their respective pulping processes, and are unwilling to make any claims about comparative economics.

POLLUTION CONTROL—The states of Oregon and Washington, where the Pacific Northwest pulp and paper industry clusters, are putting the heat on pulp and paper companies to reduce sulphite pollution in streams. The pollution control agencies of these two states are naturally going to try to get the paper companies to adopt either the ammonia or the magnesia process or some other system. That's unless stopgap measures the companies are now using prove acceptable on a permanent basis to the state agencies.

WHO'S WHO IN SCRAMBLE—Of the firms playing with the idea of building an ammonia plant in the Northwest, Shell Chemical is probably the most active. Shell is scrutinizing Tacoma, Wash., as a possible site. Pennsalt and Hooker Electrochemical, both producers of byproduct hydrogen at their caustic soda plants in Tacoma, are likewise interested. Spencer Chemical, which has been shipping ammonia from Kansas into the Northwest, isn't letting the grass grow under its feet either. Incidentally, a Montana firm is thinking about putting up an ammonia plant at Pasco, Wash.

SULPHATE PLANTS LIKELY—If an ammonia plant is built in the Northwest, it would almost certainly result in construction of additional ammonium sulphate plants in the area. Right now, the major supplier of ammonium sulphate is Consolidated Mining & Smelting, which has a plant at Trail, B. C. The freight charges on ammonia from California points, notably Pittsburg, are pretty high; this is just one more factor that encourages ammonia manufacture in the region.

Accident decline in process industries

Injury frequency rates were down in most chemical process industries in the second quarter of this year compared with the same period last year.

Fertilizer plants, with the highest rate among chemicals, declined from 32.7 to 23.1 injuries for every million man-hours worked. Others that dropped: industrial chemicals, 6.0 injuries per million man-hours; plastics, 4.5; synthetic rubber, 1.1—the lowest for any industry—and synthetic fibers, 1.3.

Those that went up are: paints and varnishes, 9.2; and explosives, 4.1 injuries—almost double the second quarter of last year, but still outstandingly low.

Newcomer in western phosphorus

While it's still hush-hush at this stage, don't be surprised if Monsanto gets into phosphorus production in the Intermountain area. Bonneville Power Administration will probably allocate firm power to Monsanto for construction of a phosphorus plant in western Montana.

Plenty of fire, but no brimstone

Sulphur consumption is at a record high. Biggest single use, of course, is in the manufacture of sulphuric acid. Output of sulphuric has been at the rate of about 1,000,000 tons since January, with consumption about the same.

Mine shipments exceeded sulphur production during the first seven months of 1950 by 93,500 tons. Apparent sales were 3,132,884 tons this year, compared with 2,854,453 tons in the same period last year. Sulphur stocks in the hands of producers, according to the Bureau of Mines, were 2,975,927 tons at the end of July, almost 167,000 tons lower than a year ago.

Freeport Sulphur has boosted the price of sulphur $4 a ton to $22 per ton for crude sulphur at the mines. With total world demand for sulphur currently outstripping supply, Freeport contends the price increase will make possible added production, prolong the life of present operations and further the effort to bring new sulphur deposits into production.

Cost of exploiting new sulphur deposits and building and operating a sulphur plant has risen sharply. At Spindletop, Tex., once famous for gushers, Texas Gulf Sulphur is putting several million dollars into a sulphur mining plant. And near Starks, La., Jefferson Lake Sulphur has put some 20 wells down an average 1,800 ft. below the surface, will spend an estimated $2.5 million for a sulphur mining plant.

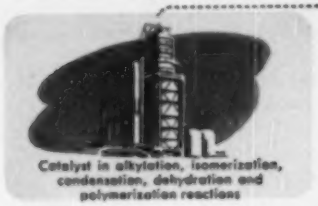
When sulphur industry executives met with National Production Authority officials in Washington recently, potential capacity, possible increases in production and overseas demands were discussed. NPA officials were pessimistic about discovery of new sulphur deposits. The military stockpile of sulphur has dwindled from about 5,000,000 tons at war's end to about half of that, a situation they characterized as "alarming." Apparently, they threatened to slap export quotas on sulphur.

Acid makers here and abroad have found it cheaper to use crude American sulphur than to work their own pyrites. Hence the tremendous increase in exports during recent months. Sulphur is already on the posi-

(*Continued on page 74*)

Anhydrous Hydrofluoric Acid

USES OF ANHYDROUS HYDROFLUORIC ACID



Catalyst in alkylation, isomerization, condensation, dehydration and polymerization reactions



Fluorinating agent in organic and inorganic reactions



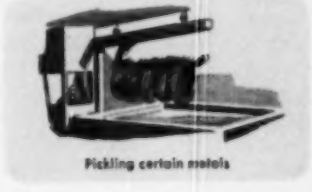
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tive list, requiring a validated export license for shipment to most destinations. To limit shipments through quotas would be a logical next step.

NPA has warned the sulphur industry that its European customers will have to start using their own pyrites. U.S. demand will come first.

Monsanto's Texas City expansion

Monsanto is dickering with Rohm & Haas to supply hydrogen cyanide from its Houston plant for production of acrylonitrile by Monsanto at Texas City. If the deal falls through, Monsanto will include a hydrogen cyanide unit as part of its $30 million expansion at Texas City.

Cyanide, acetylene and a catalyst such as cuprous chloride will probably be used by Monsanto in the production of acrylonitrile, which will be shipped to the Decatur, Ala., plant of Chemstrand, now building, for manufacture of acrylic fiber.

Monsanto's Texas City expansion will also include an oxygen unit.

Party line for chemical unions

A straw in the wind: American Federation of Labor has just told its negotiators: (1) the chemical industry expects higher profits—as much as 40 or 50 percent—despite a 42 percent increase in corporate taxes; (2) the industry thinks sales will hit a new peak this year, possibly 25 percent or more above last year; and (3) profit margins should be well maintained because larger volume, increased plant efficiency and higher prices should about offset higher wages and material costs.

Heyden resolves stock dilemma

Heyden Chemical has purchased 225,000 shares of its own common stock at $15 a share from the estate of B. R. Armour, late Heyden president. The shares will be held in the corporation's treasury. At the same time, the Armour estate sold at the same price the balance of its holdings of Heyden common. Certain officers of the corporation and their associates acquired 37,500 of these shares, and the remaining 138,970 went to certain private investors.

To get cash for the stock purchase, Heyden sold for $1,650,000 its Memphis, Tenn., plant, and disposed of the assets comprising its Rumford Division, subject to its liabilities, at their net book value aggregating about $2,450,000.

Heyden acquired the Memphis plant in September 1946 for $1,060,000 and expended approximately $500,000 in capital additions. The sale price of $1,650,000, exclusive of inventory, was about $500,000 in excess of the depreciated net book value of the plant. Since its acquisition, the Memphis plant had been operating at a loss.

The Rumford properties were acquired by Heyden in November 1948 in exchange for 99,438 shares of Heyden common stock. The Rumford Division had made only a negligible contribution to the earnings of the corporation.

Disposition of the large block of stock held by the Armour estate removes uncertainties as to Heyden's future that had troubled the management. Also, the reduction in the number of common shares outstanding from 1,291,010¼ to 1,066,010½ will increase earnings per share of the remaining common shares outstanding.

Long a producer of organic chemicals, Heyden in recent years has moved into antibiotics, which now constitute an important part of its business.

High-pressure hydrogenation

Only commercial plant in the U. S. that uses the Italian De Nora process for the high-pressure hydrogenation of fats and fatty acids to fatty alcohols is the one at Long Beach, Calif., operated by Procter & Gamble. A semi-continuous experimental unit, the plant can turn out about 5 tons per day.

In De Nora plants, both hydrogen and fats are preheated to such temperatures that, with the addition of the heat developed by the synthesis, the optimum reaction temperature is reached. The reaction takes place in two successive steps, without discontinuity. In the first, by circulating hydrogen at a high rate, to displace the equilibrium by eliminating water of reaction, a rapid formation of fatty esters is achieved, starting from fats or fatty acids. In the second, the fatty esters are reduced to alcohols. Yields approach the theoretical ones, with minimum consumption of catalyst.

Heart of the Long Beach plant is a vertical reaction chamber, electrically heated, and operating at approximately 4,200 psi. and 600 deg. F. Hydrogen is electrically heated to 650 deg. F. and introduced into the bottom of the reactor. The fatty acid is mixed with powdered copper chromite catalyst, pumped through an electric heater that brings it to 550 deg. F., and charged into the top of the reactor. Unreacted hydrogen emerging from the top of the reactor is recycled with the stream of fresh hydrogen entering the reactor. Liquid products from the bottom of the reactor (fatty alcohols and any unreacted fatty acid) are filtered to remove spent catalyst, and the alcohols are sent to a purification still.

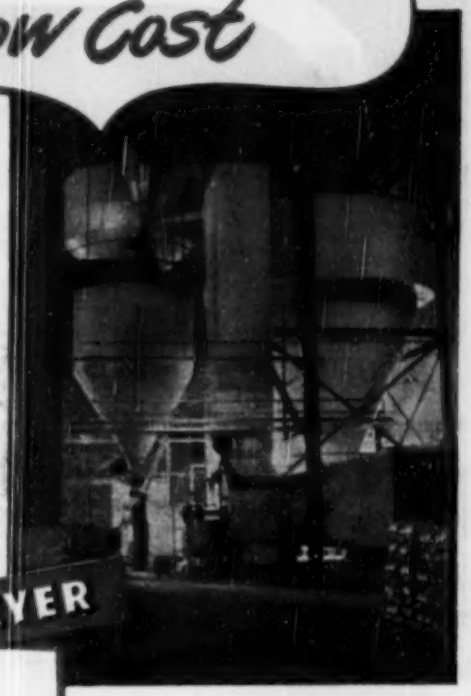
The alcohols are reportedly in the C_{12} to C_{16} range. Procter & Gamble is believed to be using them in its synthetic detergents.

De Nora plants are designed for rated capacities from 1,000 to 50,000 lb. per 24 hr. For capacities of 10 tons daily and higher, the plants are designed to operate continuously; for lower capacities, the process is semi-continuous. De Nora plants are easy to operate, and give high-quality products at low manufacturing cost. —*End*

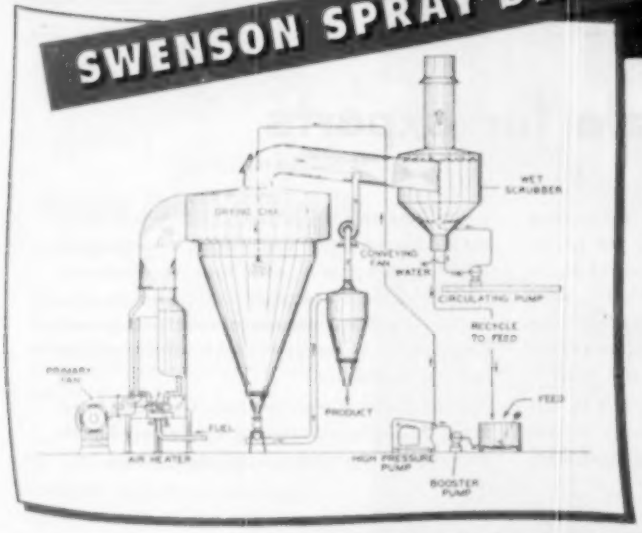
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Here is high-capacity spray-drying equipment that is especially suitable for handling heavy chemicals. It is direct fired, uses either oil or gas as fuel, and gives amazingly low-cost operation.

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Direct-fired spray drying may be used for such materials as:

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Calcium carbonate

Chrome sulfate

Sodium phosphate

Flow sheet shows typical spray-dryer installation for handling heavy chemicals.

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Puzzle for experts

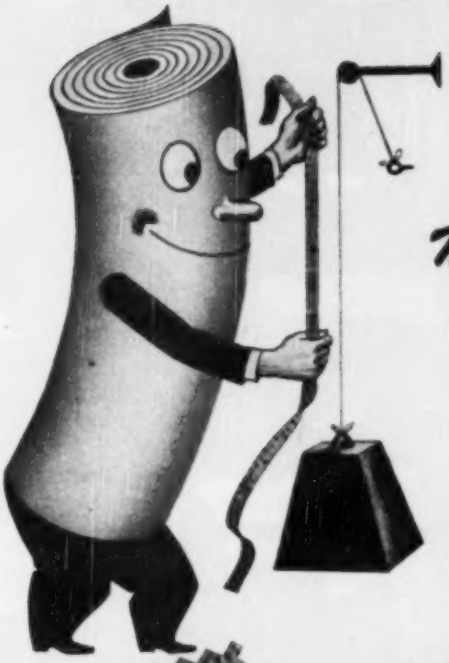
There is no need for "cutting and trying" on the job to make a prefabricated piping sub-assembly fit perfectly. Prefabricated miles away to exact dimensions and specifications these pieces of piping are links in piping systems which may carry steam up to 2500 p.s.i. and 1050°F.

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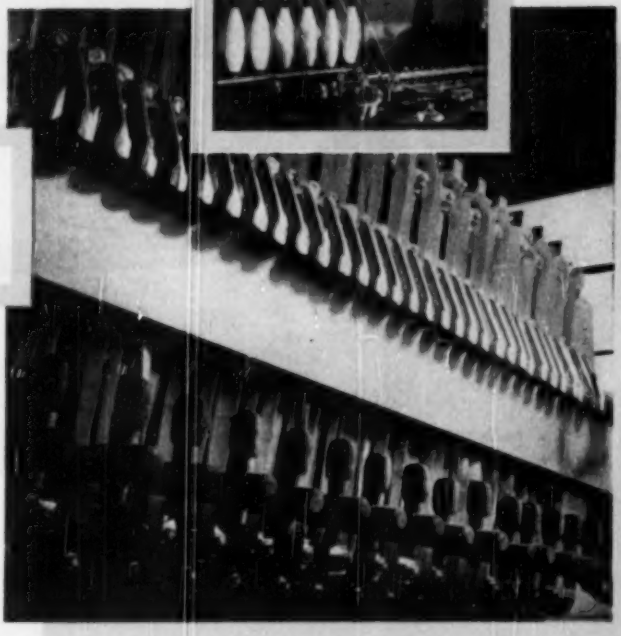
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Greater Fabric Uniformity





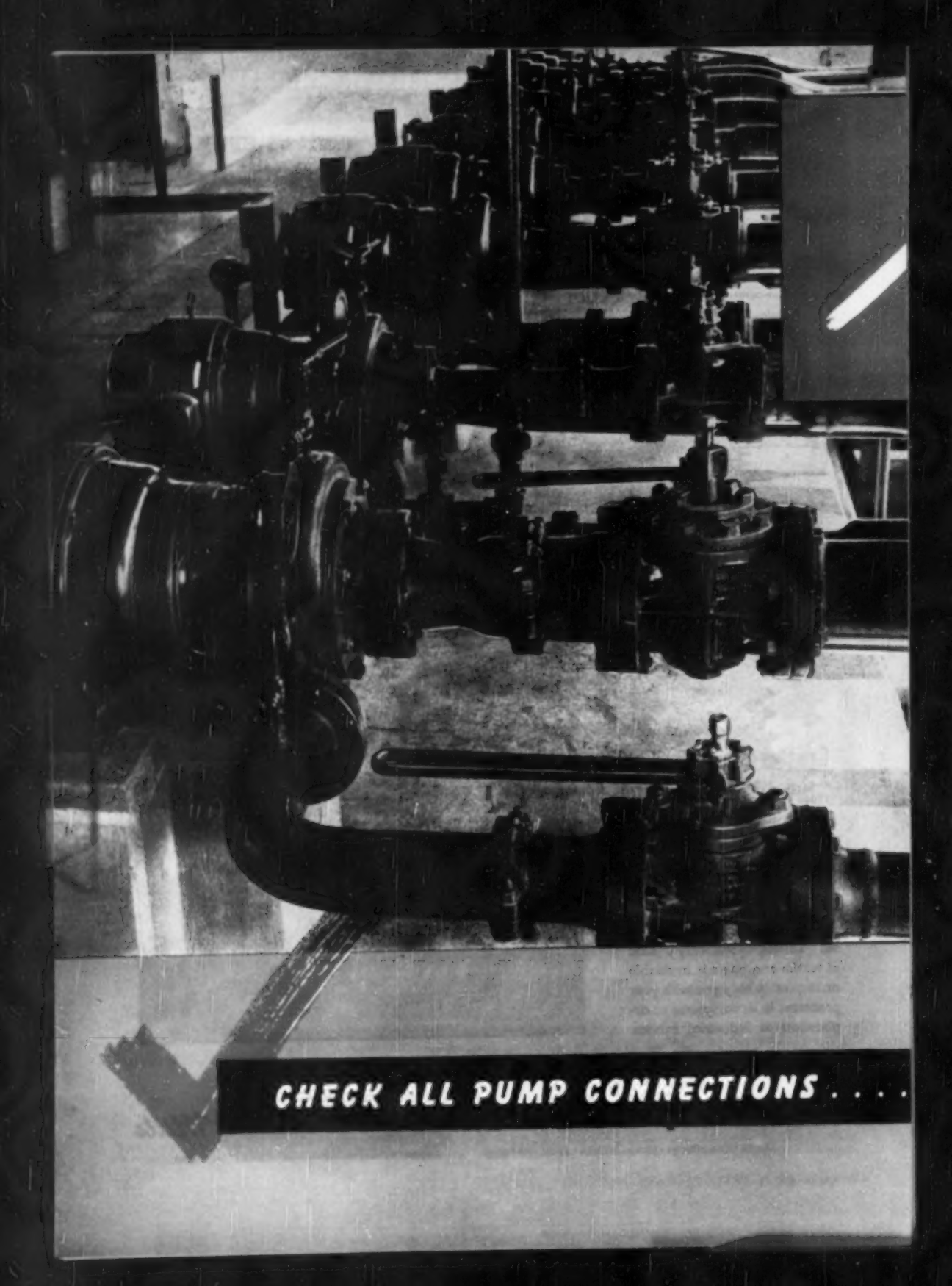
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OF VALVE REPLACEMENTS ON ALL PUMP CONNECTIONS

Valve failure on pump lines is a hazard, especially in closed areas and where every precaution must be taken to avoid disaster. Some operators follow an old and dangerous habit of merely replacing a troublesome valve with a like valve, assuming that the new "old" valve will be a remedy. But if the old valve were right in the beginning it probably wouldn't need replacing.

Get the new, improved habit—replace with Nordstroms. Recheck each valve on your pump connections. Requisition Nordstroms. Make this standard practice—and eventually you'll have a really up-to-date set of valves that will end your valve problems permanently.

Nordstroms save space in restricted pump locations. They give positive shut-off because a quarter turn of the plug is an absolutely sure operation as contrasted with a valve dependent upon an exposed disc and seat that must be jammed together.

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NOW AUTOMATICALLY LUBRICATED WITH Hypermatic

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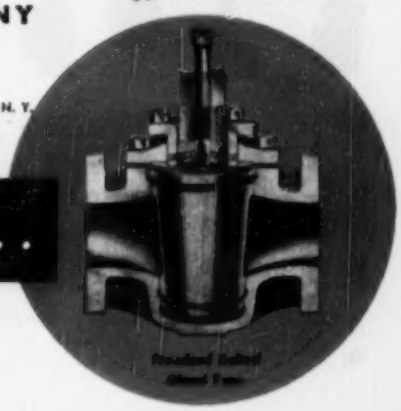
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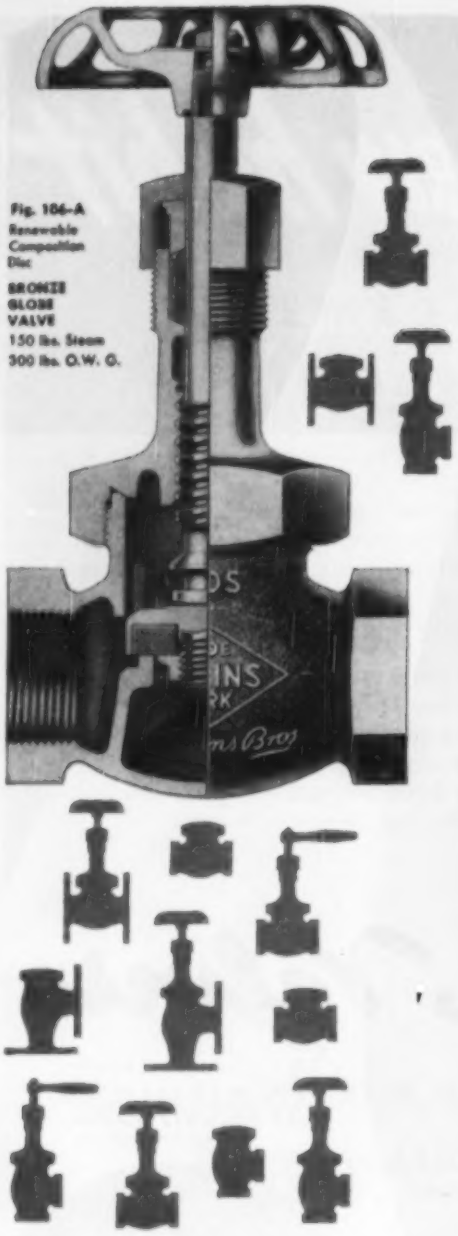


Fig. 106-A
Renewable
Composition
Disc

BRONZE
GLOBE
VALVE
150 lbs. Steam
300 lbs. O.W. G.

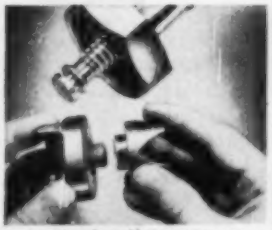
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Valve combinations for 90% of industrial piping assembled with 4 bodies and a handful of parts.

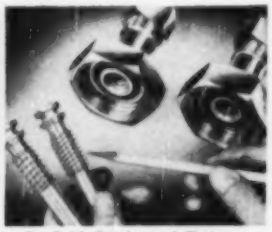
JENKINS FIG. 106-A "FAMILY"

Start with the standard Fig. 106-A. Trimming is interchangeable in Globe or Angle body, screwed or flanged.





For Close Control — In throttling service, the nut which holds the disc in the disc holder is removed and replaced with Throttling Nut, Fig. 344.



For Quick Opening and Closing — Herein substitute the bonnet and spindle from Fig. 941, in which threads are pitched more sharply.



For Lift Check Service — Globe or Angle Bodies can be fitted with interchangeable Cap, Disc Holder, and Guide Disc Nut from Fig. 117A. Addition of spring from Fig. 655A provides spring loaded service.



For Stop & Check Service — Use the 106A trim, but substitute this spindle from Fig. 630A and replace the regular disc nut with the check valve guide disc nut.

Look over these pictures and see how easy it is to make up just the valve type you need, simply by interchanging parts. Think of the saving this means in maintenance expense . . . in reduced inventory of spare valves in your stockroom.

That's a big reason why the Fig. 106-A series takes top honors in any poll for valve preference. And Jenkins time-proved design, makes them the longest-lasting, lowest-upkeep valves that money can buy.

For example, see the heavy construction of the one-piece, screw-over bonnet. You can remove and replace it over and over again without distortion. See the extra size packing box,—and the perfectly machined threads on the heavy manganese bronze spindle, with more threads in contact with the bonnet, open or closed.

Remember, Jenkins Bros. is the originator of the renewable composition disc valve,—the *only* manufacturer of both valves *and* discs. For drop-tight, trouble-free performance, get acquainted with the Fig. 106-A "family". Despite their extra value, *you pay no more* for Jenkins Valves. Jenkins Bros., 100 Park Ave., New York 17, N. Y. Jenkins Bros., Ltd., Montreal. Sold through leading Industrial Distributors.

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VALVES

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Listed below are some of the characteristics of Hooker Monochloroacetic Acid. Technical Data Sheet 752-B gives more complete listing of physical and chemical properties. It will be sent you upon request made on your company letterhead.

MONOCHLOROACETIC ACID

DESCRIPTION: White crystalline material with a strong sweetish odor. Corrosive to the skin. Very soluble in water and benzene; soluble in most organic solvents.

Synonyms	Chloroacetic Acid, Chloroethanoic Acid	Boiling Point	189°C
		Solubility	
Formula	$CH_2ClCOOH$	Water	Very soluble
Molecular Weight	94.5	Benzene	Very soluble
Freezing Point	61.6°C	Other organic solvents	Generally soluble

USES: Intermediate in manufacture of carboxymethylcellulose, 2,4-dichlorophenoxyacetic acid, cyanoacetate, indigoid and thioindigoid dyes, ammonium thioglycolate, thioglycolic acid, glycine and other chemicals of commercial importance. It has been suggested as a preservative alone or in connection with other compounds for hides, skins, etc.

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Squeezing through narrow congested areas is a cinch for "Stubby." Here's why: "Stubby" is 6 inches shorter than other Worksaver models. But it's cut down in length only . . . all the efficient qualities standard in Yale Worksavers are part of "Stubby," too! "Stubby" Worksavers can be had in pallet or platform lengths to suit your exact needs . . . in 4,000 and 6,000 lb. capacities.

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2. ***Power-packed Drive Unit*** has improved motor efficiency.

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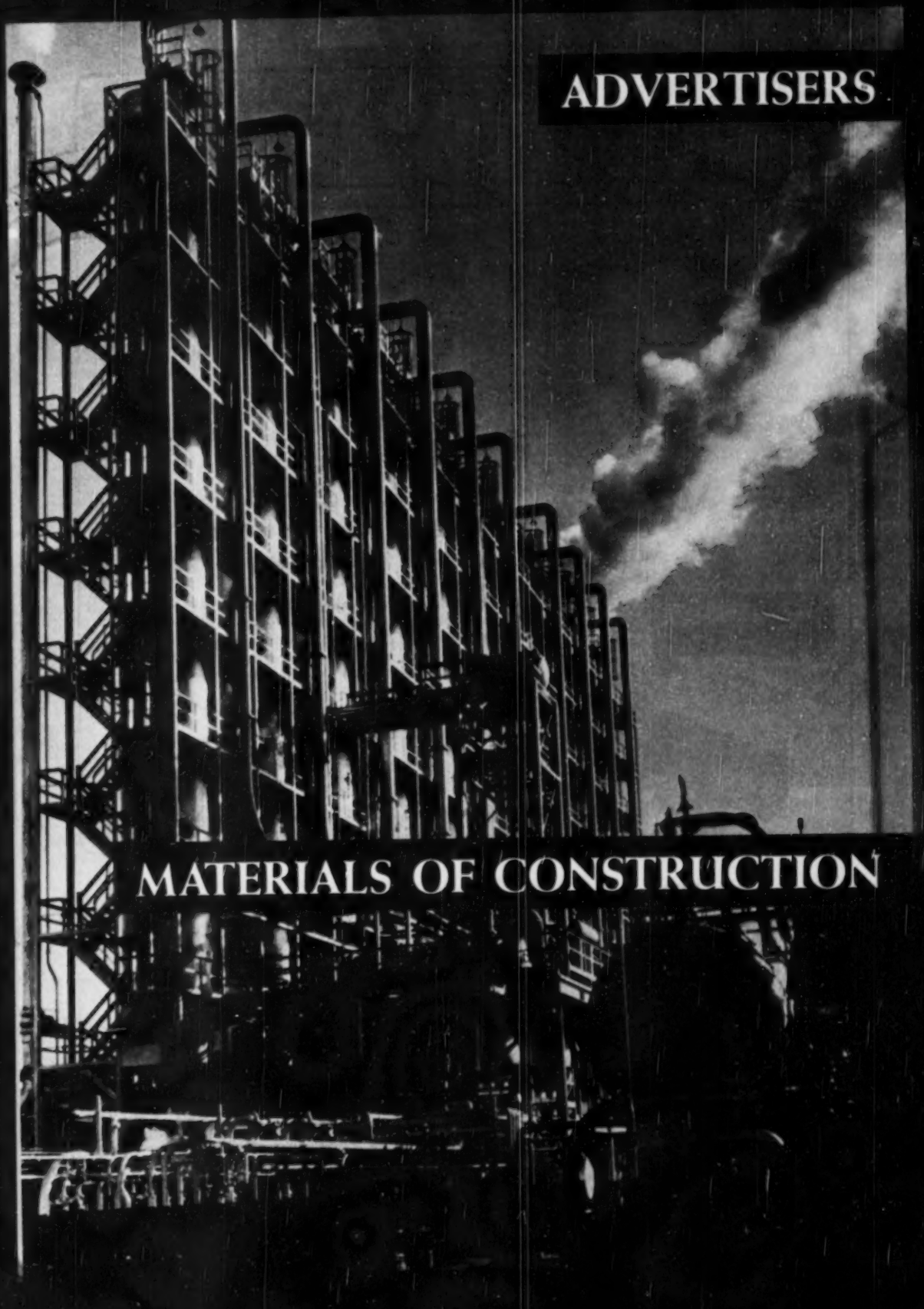
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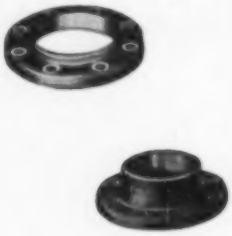
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SIZE RANGE OF GLOBE SEAMLESS WELDING FITTINGS

Description of Fitting	Standard Weight (Schedule 40)	Extra Strong (Schedule 80)	(Schedule 160)	Double Extra Strong
Elbows 45° Long Radius	½ in. to 24 in.	⅜ in. to 24 in.	1 in. to 12 in.	1 in. to 8 in.
Elbows 90° Long Radius	½ in. to 24 in.	⅜ in. to 24 in.	1 in. to 12 in.	1 in. to 8 in.
Elbows 90° Short Radius	1 in. to 24 in.	1½ in. to 24 in.	- - -	- - -
Returns 180° Long Radius	½ in. to 24 in.	1 in. to 24 in.	1 in. to 12 in.	3 in. to 8 in.
Returns 180° Short Radius	1 in. to 24 in.	1½ in. to 24 in.	- - -	- - -
Reducers (Concentric and Eccentric)	1 x ½ in. to 24 x 20 in.	1 x ½ in. to 24 x 20 in.	1 x ½ in. to 12 x 10 in.	1 x ½ in. to 12 x 10 in.
Tees Straight	¾ in. to 24 in.	½ in. to 24 in.	1 in. to 12 in.	1 in. to 8 in.
Tees Reducing Outlet	¾ in. to 24 in.	½ in. to 24 in.	1 in. to 12 in.	1 in. to 8 in.
Stub Ends Lap Joint	1 in. to 24 in.	1 in. to 24 in.	- - -	- - -
Caps	1 in. to 24 in.	1 in. to 24 in.	1 in. to 12 in.	1 in. to 8 in.

Flanges available 1 inch to 24 inches in all weights



Producers of Globe Seamless Stainless Steel Tubes —Gloweld Welded Stainless Steel Tubes—Carbon — Alloy — Seamless Steel Tubes — Globeiron Seamless High Purity Ingot Iron Tubes and Pipe.

...The COMPLETE Line for ALL CORROSION-RESISTANT piping problems

It's TRI-CLOVER



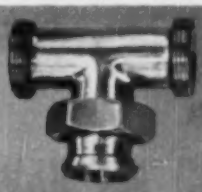


"ZEPHYRWELD"® WELDING FITTINGS ... 95 Type 304, 347 and 316—Inconel and other SS analyses. Fabricated in I.P.S. and O.D. Tube Size, ½ in. thru 24 in.—ells, tees, crosses, flanges, adaptors, etc.

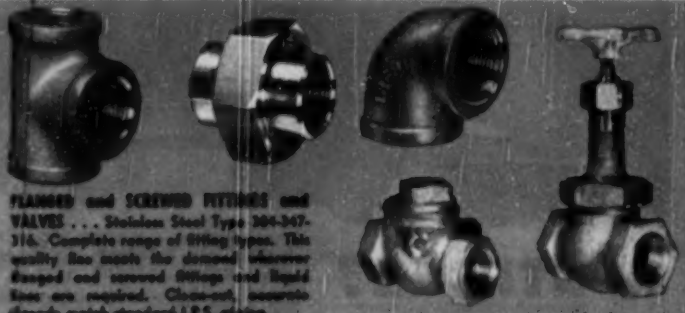


COUPLING AND FITTINGS ... Stainless Steel Type 316—Inconel and other SS analyses. Complete line of ells, tees, crosses, laterals, reducers, etc., sizes from ¼ in. thru 4 in. O.D. Features: Light weight—save cost—simple, fast installation—leaktight—Range of all types for every application—easily adapted to all other fitting types.

RECESSED-END FITTINGS ... Stainless Steel Type 304-347-316. Low cost, light weight fittings designed for fast, simple soldering, brazing or socket welding, in sizes from ¼ in. thru 24 in. Full line of elbows, return bends, tees, crosses, adaptors, etc.



"SANITARY" TYPE FITTINGS ... Stainless Steel and Tri-Alloy (Nickel Alloy). Sizes from 1 in. thru 4 in. O.D., in full range of fitting types. Designed and approved as meeting 3A Standards throughout, incorporating numerous exclusive design and construction features.



FLANGED and SCREWED FITTINGS and VALVES ... Stainless Steel Type 304-347-316. Complete range of fitting types. This quality line meets the demand wherever flanged and screwed fittings and liquid lines are required. Close-cut, accurate threads match standard I.P.S. piping.

SPECIALIZED MANUFACTURING FACILITIES

When it comes to expert welding and fabricating of complex assemblies, you just can't beat the speed and accuracy offered with TRI-CLOVER'S exclusive Heli-Arc Atomic Hydrogen Welding... a specialized semi-automatic process that assures highest quality and FULL corrosion resistance. *Shown here are a few typical examples of the wide variety of jobs we handle every day.*

COMPLETE ANNEALING FACILITIES

EXPORT DIVISION 8 So. Michigan Ave., Chicago 3, U.S.A.



(Above): Special welded SS tubing and flanges. (Below): Tri-Clover Industrial Pumps — for every corrosion problem — capacities up to 1200 GPM and up to 300 ft. head.



(Left and Right): Stainless Steel coils of every size and description to meet specific requirements.



(Above): Standard Tri-Clover built-welded fittings furnished in flanged assemblies.

Tri-Clover MACHINE CO. Kenosha, Wisconsin

TRI-ALLOY AND STAINLESS STEEL SANITARY FITTINGS, VALVES, PUMPS, TUBING, SPECIALTIES

The Complete Line

FABRICATED STAINLESS STEEL INDUSTRIAL FITTINGS AND INDUSTRIAL PUMPS



STRIKE?

no..they're out because of a broken bolt!

You're looking at a group of production workers who have been laid off temporarily—because a certain bolt in an all-important drive corroded to failure.

One of the most regrettable aspects of this situation is that it *could* have been avoided . . . by specifying non-ferrous or stainless steel fastenings at the time the equipment was purchased; or by replacing common steel fastenings *on delivery* with bolts, nuts, screws, rivets and accessories that *resist* corrosion.

Harper specializes in these Everlasting Fastenings; makes them in over 7000 different sizes, types and alloys—Brass, Bronzes, Copper, Monel and Stainless Steels. Large quantities are maintained in stock for immediate delivery to manufacturers everywhere who know by experience the extra qualities you get in Harper fastenings—better appearance, longer life, ease of cleaning and resistance to high temperatures. They're most economical in the long run.

Write today for 134-page catalog and current stock list.
The H. M. Harper Company, 8206 Lehigh Avenue, Morton Grove, Illinois

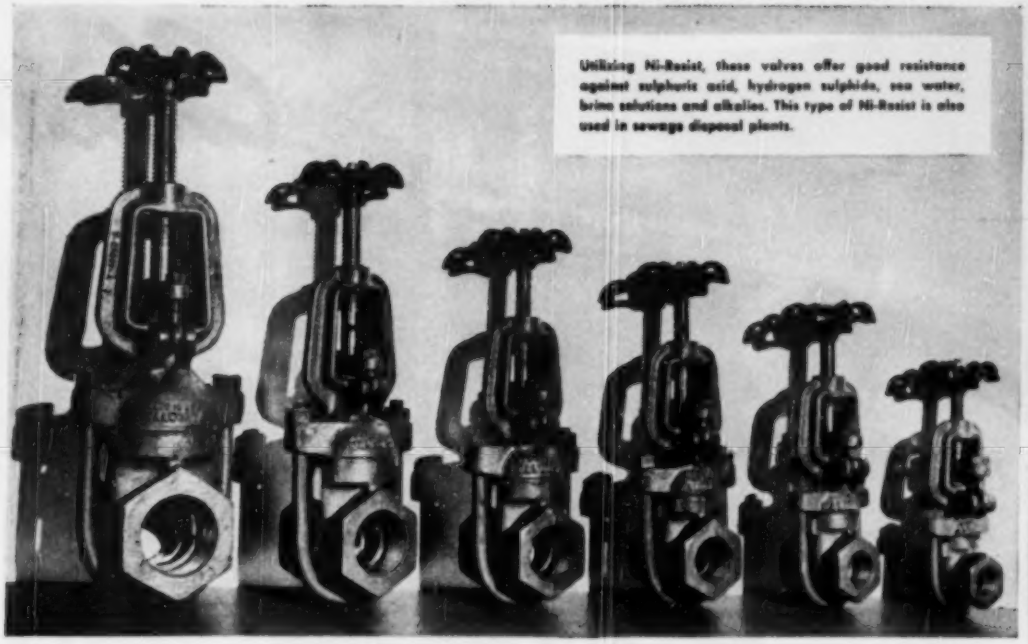


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HARPER

EVERLASTING FASTENINGS



Utilizing Ni-Resist, these valves offer good resistance against sulphuric acid, hydrogen sulphide, sea water, brine solutions and alkalies. This type of Ni-Resist is also used in sewage disposal plants.

New Walworth Valves

WAR ON CORROSION...MAINTAIN PRODUCT PURITY

...with the help of Ni-Resist

ATTENTION: ***Pulp and paper mills, chemical plants, oil refineries and all other process industries...***

Bodies, bonnets and wedges of the valves shown above are cast in Ni-Resist®, a high nickel alloy iron that resists corrosive attacks of *acids, alkalies* and *salts* to a degree unmatched by any other product of the cast iron industry.

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In strong corrosives, Ni-Resist has 20 to 200 times the resistance of plain iron, and 5 to 50 times the resistance in mild environments.

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Please send me free booklets entitled: "Engineering Properties and Applications of Ni-Resist" and "Buyers Guide for Ni-Resist Castings."

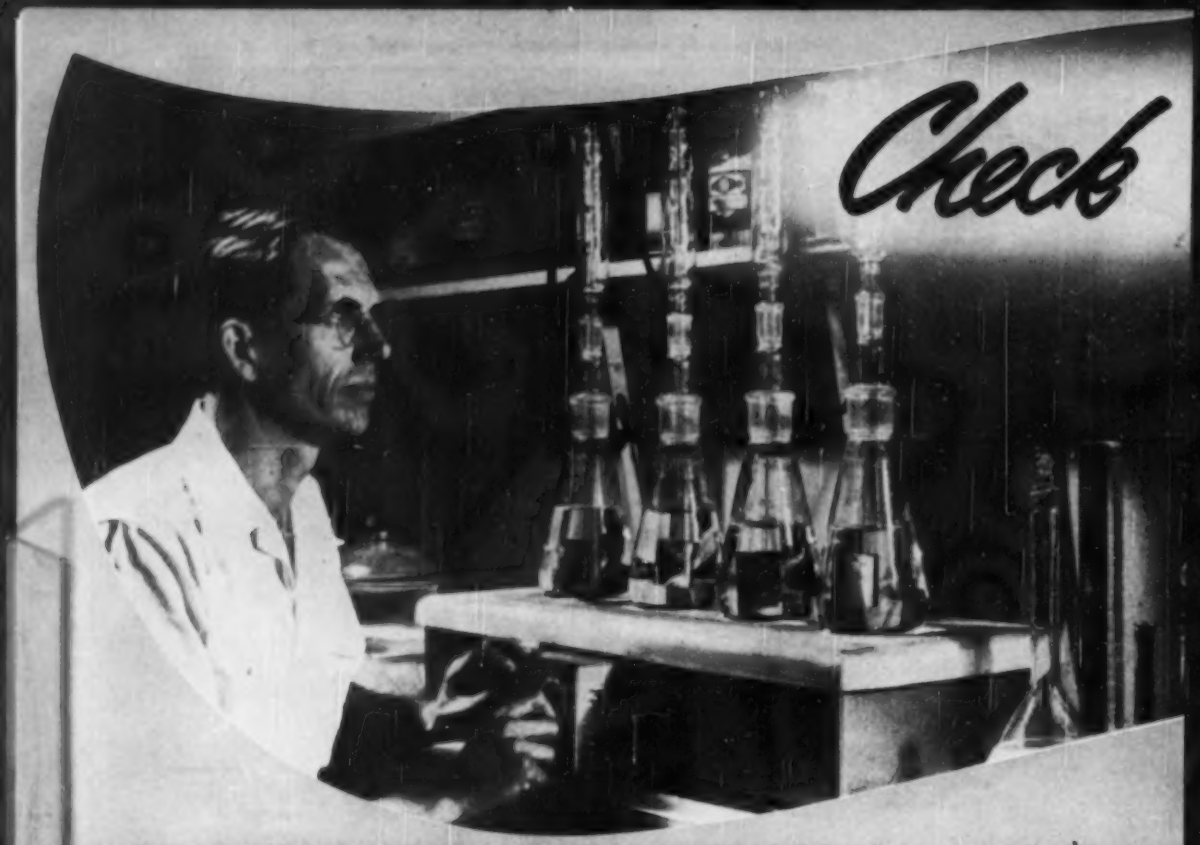
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- Absorption columns
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- Acid chain
- Agitators
- Autoclaves
- Baskets
- Bearings
- Beater Bars
- Bellows
- Bolts and nuts
- Brazing rod
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- Bubble caps and trays
- Calandrias
- Condenser shells
- Condenser tubes
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- Control valves
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- Evaporators
- Evaporator tubes
- Extractors
- Fabricated assemblies
- Filters and filter screens
- Filter presses
- Fittings — forged, cast
- Forgings
- Fractionating columns
- Hangers
- Heat exchangers
- Heater coils
- Hooks
- Injectors
- Instrument cases and elements
- Kettles
- Line hardware
- Meter cases
- Mixers
- Pans, evaporator
- Perforated plate
- Pickling baskets
- Pipe and fittings
- Plug cocks
- Pressure vessels
- Pumps
- Reboilers
- Retorts
- Rivets
- Safety tools
- Screens
- Screws, conveyor
- Sludge burners
- Springs
- Stills
- Studs
- Sucker rod
- Tanks
- Tools, safety
- Towers
- Trays, fractionating
- Tubes and tubing
- Vats
- Valves
- Welding rod
- Well tubing
- Wire
- Woven wire cloth

Chemical Agents and the Applicability of AMPCO Alloys

Acetate Solvents (Pure)	E	Carbon Dioxide		Hydrogen Sulfide		Potash Crudes	E	Toluene or Toluol	E
Crude	G	Dry	E	Wet	NR	Propane	E	Tri Chlorethylene	E
Acetic Acid		Wet	G	Dry	F	Shellac	E	Tri Sodium Phosphate	E
Crude	E	Carbon Disulfide	F	Lacquers and Lacquer Solvents	E	Soaps	E	Turpentine	E
Vapors	E	Carbon Tetrachloride	E	Lactic Acid	E	Soda Ash		Varnish	E
Acetic Anhydride	G	Caustic Soda	E	Magnesium Chloride	G	(Sodium Carbonate)	G	Vegetable Oils	E
Acetone	E	Chlorine Dry	G	Magnesium Hydroxide	E	Sodium Bicarbonate	E	Water	
Acetylene	NR	Wet	NR	Magnesium Sulfate	E	Sodium Bisulfate	E	Fresh	E
Alcohols	E	Chloroform	E	Malt Beverages	E	Sodium Carbonate	E	Salt (includes Polluted Harbor)	E
Aluminum Fluoride	G	Chromic Acid	NR	Mercuric Chloride	NR	Sodium Chloride	E	Xylene	E
Aluminum Sulfate	G	Citric Acid	E	Milne Water (Sulfate)	E	Sodium Cyanide	NR	Zinc Chloride	G
Aluminum Hydroxide	E	Copper Sulfate	NR	Molasses	E	Sodium Hydroxide	E	Zinc Sulfate	E
Ammonia Gas		Crude Oils — Sour	G	Monochlorobenzene	E	Sodium Nitrate	G		
Dry	G	Esters	E	Muriatic — Cold, Commercial	G	Sodium Perborate	E		
Wet	NR	Ethers	E	Naphtha	E	Sodium Peroxide	F		
Ammonium Chloride	NR	Ethylene Glycol	E	Natural Gas	E	Sodium Phosphate			
Ammonium Hydroxide	NR	Ethyl Sulfate	E	Nickel Chloride	E	Alkaline	E		
Ammonium Nitrate	F	Ferric Chloride	NR	Nickel Sulfate	G	Neutral	E		
Ammonium Phosphate	F	Ferric Sulfate	NR	Nitric Acid	NR	Acid	E		
Ammonium Sulfate	F	Formaldehyde	E	Nitrogen (Dry)	E	Sodium Silicate	E		
Amyl Chloride	E	Formic Acid	E	Oleic Acid	E	Sodium Sulfate (Soda Cake)	E		
Asphalt	E	Freon	E	Oxygen	E	Sodium Sulfide	NR		
Barium Chloride	G	Furfural	E	Paint Vehicles (Except Soya Oil)	G	Sulfur	F		
Beer	E	Gasoline	E	Palmitic Acid	E	Sulfur Chloride	NR		
Boot Sugar Liquors	E	Gelatine	E	Petroleum Oils Sour	G	Sulfur Dioxide Dry	G		
Benzene or Benzol	E	Glucose	E	Refined	E	Wet	G		
Borax	E	Glycerine	E	Phenol	E	Sulfuric Acid			
Boric Acid	E	Hydrocarbon Gases	E	Phosphoric Acid	E	5%	E		
Brine	E	Hydrochloric Acid		Pickling Acid (except Nitric Chromic)	E	10%	E		
Butane, Butylene	E	to 5%	G	Potassium Chloride	E	25% Up to Boiling	E		
Butadiene	E	to 10%	F	Potassium Cyanide	NR	35%	E		
Butyric Acid	E	(see Muriatic)		Potassium Hydroxide	F	50%	E		
Calcium Bisulfite	G	Hydrocyanic Acid	NR	Potassium Sulfate	E	Sulfuric Acid Sludge	E		
Calcium Hydroxide	G	Hydrofluoric Acid	G			Sulfurous Acid	G		
Calcium Hypochlorite	F	Hydrogen Fluoride (Dry)	E			Tannic Acid	G		
Cane Sugar Liquors	E	Hydrogen	E			Tartaric Acid	E		
Carbolic Acid	E	Hydrogen Peroxide	F						

These ratings may usually be interpreted as follows:

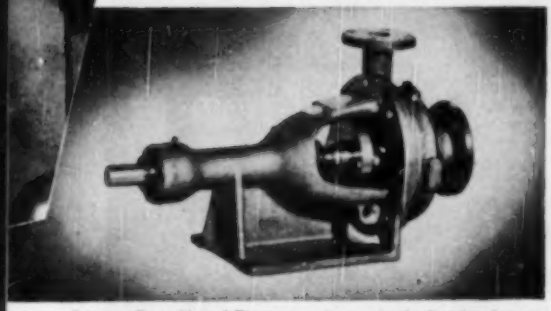
- E — Excellent — IPY Penetration < 0.006"
- G — Good — IPY Penetration < 0.016"
- F — Fair — IPY Penetration < 0.050"
- NR — Not Recommended — IPY Penetration Over 0.050"

In using this data, it should be understood that these are results of specific tests and are indicative of those conditions under which the tests were run, and are a basis for recommendation, but not for guarantee.

AMPCO

Your Corrosion Problems ...use Ampco Alloys

... these unique properties have proved to be the best answer to many process equipment problems



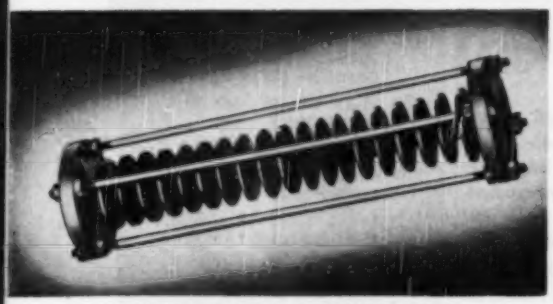
Ampco Centrifugal Pumps — Here — for the first time in pump manufacturing history — is a "production-built" and "production-priced" pump to handle acids, alkalies, and other corrosive agents hitherto requiring specially built pumps. The Ampco single-stage, single-suction centrifugal pump offers long life, high efficiency and low maintenance costs through the combination of correct design and properly selected materials.

1. High resistance to corrosion
2. High tensile strength
3. High physicals at extreme temperatures
4. High strength to weight ratio
5. High impact and fatigue values
6. High wear-resistance — to erosion — corrosion — cavitation, etc.
7. High compressive strength
8. High modulus of elasticity

Designers and plant engineers in the process industries are turning to Ampco Alloys more and more frequently — because of the outstanding savings offered by their long-lasting qualities.

Costs are reduced in three ways: 1. Minimum down time, 2. Minimum product loss from parts failure, and 3. Minimum maintenance and replacement expense.

Study the list of time-proven applications and the Ampco applicability chart and apply this data to your own needs. Plan your own economies now by specifying Ampco Bronze Alloys for corrosive and erosive media handling. Write today for recommendations and complete information.



CORROSION TESTING—Types of Test Specimens — A complete stock of test specimens of a wide variety of materials is kept ready for mounting on racks. Several forms of racks are available for tests in atmospheric locations, pipe lines, tanks or other pressure vessels. When requesting test specimens please outline conditions under which test is to be conducted so that we may supply the most suitable form.

★ ★ ★

Ampco aluminum bronzes are available in a number of grades to meet your exact requirements in any form you need: rolled sheet or plate, sand or centrifugal castings, forgings or extrusions . . . pipe and fittings. Also, Ampco's arc-welding electrodes, corrosion-resistant centrifugal pumps and plug valves.

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AMPCO

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Send me your free bulletin, giving full information on the application of Ampco Alloys in the Process Industries.

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- ROTATING SEALS OF GRAPHALLOY ARE UNEXCELLED

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ACID GOT THE BITE ON YOU?

—pack it away with

PALMETTO'S SUPER-CUTNO



Built to take the punishment of sulphuric, nitric, mixed, heavy and other acids -- and service on all acid-handling pumps and valves. Select long fibre pure blue asbestos . . . each strand impregnated with special acid-resisting self lubricant. Will not score, overheat, or nitrate. Plaited, twisted, ring.

Let Palmetto Blue Asbestos also take the bite out of acid problems as pressure-bonded Sheet, as Dry Blue Rope.

- **Write for full particulars on the *entire* Palmetto line of packings for all industry.**

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NORTH WALES, PENNSYLVANIA

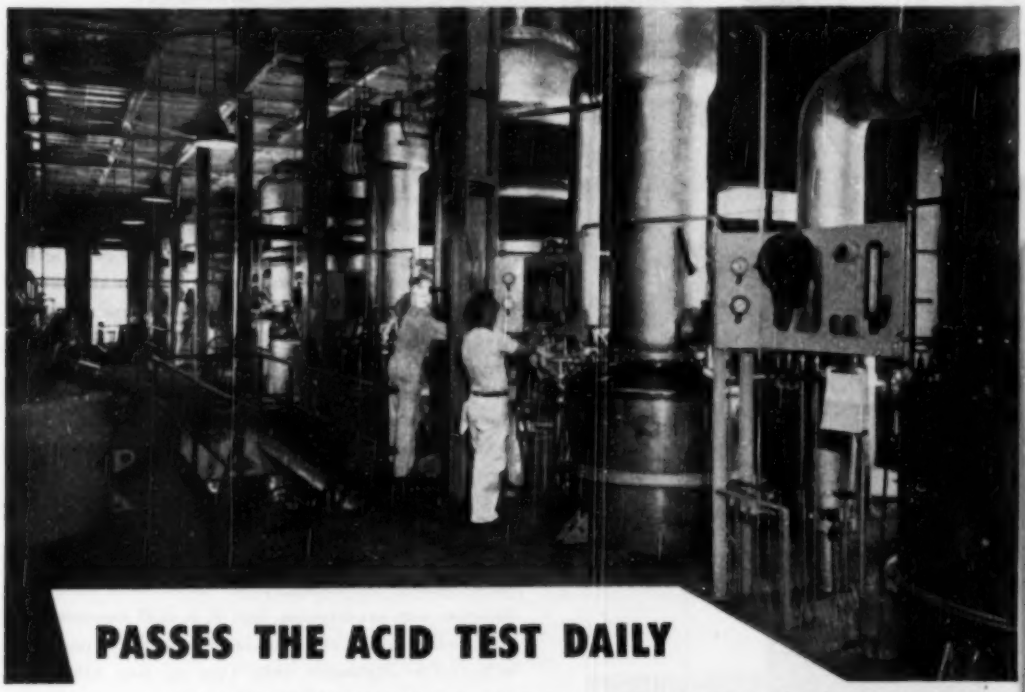
Contact your fully-stocked Palmetto distributor on all packing problems . . . ask him about our special tools.

Enduro STAINLESS STEEL

THRIFTY METAL OF 10,000 USES



Evaporators of ENDURO Stainless Steel constitute a first line of defense against contamination — in the processing of pharmaceuticals or industrial chemicals. Wherever there is direct contact with the product in process—from digesters to nozzles — all-ENDURO equipment assures product purity and process efficiency.



PASSES THE ACID TEST DAILY

Most acids and alkalies in process—hot or cold — have little or no effect on process lines and equipment of ENDURO Stainless Steel. In addition, ENDURO is highly resistant to rust, corrosion and to extremes of temperature.

Its smooth, pore-free, sanitary-as-glass surface is easy to clean and keep clean — allows no foothold for contaminants. And being itself chemically inert, it sets up no metallic or chemical reactions with the product in process. It safeguards quality.

Little wonder that so much of today's chemical process equipment of all types is ENDURO. For, in addition to its protection of product purity, ENDURO holds maintenance to a minimum, equipment life maximum and productivity both high and constant.

In the long run, it pays to pay more for ENDURO. Ask your equipment supplier or your nearest Republic representative.

✓ **CHECK ALL 12 ADVANTAGES:** Rust- and Corrosion-Resistance • Heat-Resistance • High Melting Point • Low Coefficient of Expansion • High Strength • Good Dimensional Stability • No Metallic Contamination • Easy to Clean • Easy to Fabricate • Eye Appeal • Long Life • Low End Cost • *What more can be desired in a material?*

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For Complete Details Write

REPUBLIC STEEL CORPORATION

Alloy Steel Division, Massillon, Ohio • GENERAL OFFICES, CLEVELAND 1, OHIO • *Export Dept.: Chrysler Bldg., New York 17, N.Y.*



The chemists certainly know a thing or two about Stainless Steel

YOU don't have to be connected with the process industries to know that many details of chemical processing are vital and closely-held secrets. But it's no secret that a very large share of this production, whether hush-hush or not, is conducted in equipment made of stainless steel—for the excellent reason that stainless steel is the *one* material that best meets the need for great strength and high resistance to corrosion, heat and wear.

Put it this way: Allegheny Metal equipment gets the call because stainless steel lasts longer, looks better, cleans easier and quicker, maintains top purity standards and holds maintenance and depreciation costs down to the bottom.

That's why Allegheny Metal is a highly essential material, especially in time of national need. We've spent (and are spending) many millions of dollars to increase our production, but it is still necessary to make every ton of stainless steel go as far as possible. ● Let our engineers help you *to use* Allegheny Metal and other alloy steels to the best advantage.

* * * * *

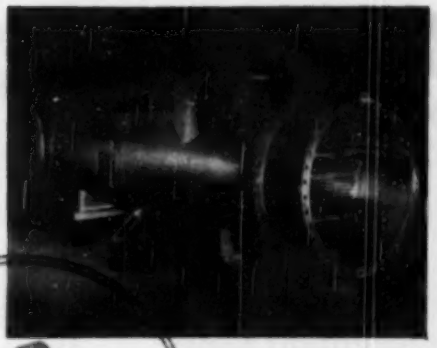
Complete technical and fabricating data—engineering help, too—are yours for the asking from Allegheny Ludlum Steel Corporation, Pittsburgh, Pa. . . . the nation's leading producer of stainless steel in all forms. Branch Offices are located in principal cities, coast to coast, and Warehouse Stocks of Allegheny Stainless Steel are carried by all Joseph T. Ryerson & Son, Inc. plants.

You can make it **BETTER** with

Allegheny Metal

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AL TIME-TESTED STAINLESS STEEL



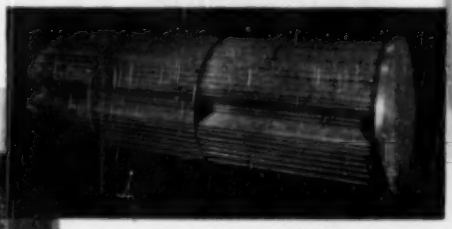
3,000-sq.-ft. condenser; shell and tube sheets of Everdur; shell fabricated with Everdur Welding Rod. Used with ANACONDA Copper Tube bundle not shown.

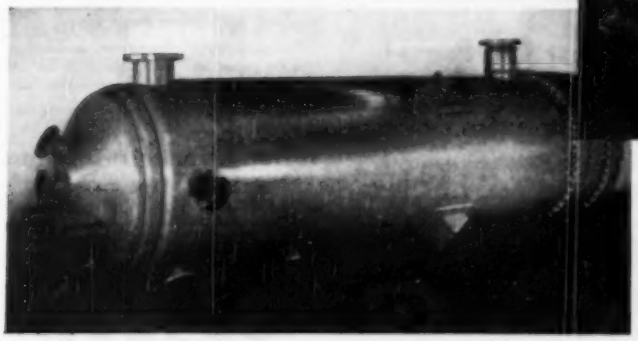
TOP SECRET

We can't tell you what these heat exchangers are for. It's top secret.

We are permitted to say that the shells and tube sheets are made of Everdur*, the tubes of ANACONDA Copper, and that the shells are fabricated by inert-gas-shielded arc welding with Everdur Welding Rod. But it's no secret that you can count on ANACONDA Copper and Everdur Copper-Silicon Alloys for top performance in process equipment.

Anaconda's Technical Department invites the responsibility of helping you determine the best materials for your process equipment. Write to The American Brass Company, Waterbury 20, Connecticut. In Canada: Anaconda American Brass Ltd., New Toronto, Ontario.





Photos by courtesy of Alberger Heater Division of Howard Iron Works, Inc., Buffalo, N. Y., fabricator of these units.

At left: 2,600-sq.-ft. jacketed condenser; shell and tube sheets of Everdur; shell fabricated with Everdur Welding Rod. *Above:* ANACONDA Copper Tube bundle used in this unit.

*Reg. U. S. Pat. Off.

For copper and its alloys—consult ANACONDA®

Put Glass Pipe On The Job!

NEW PYREX brand "DOUBLE TOUGH" GLASS PIPE

Saves Thousands of Dollars in Installation and Replacement Costs

STRONGER—Made from heavy wall tubing with machine drawn uniformity. Ends of all straight lengths and all standard fittings (except U-bends) are *tempered for extra strength*. Sudden temperature changes are no problem.

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CHEMICAL RESISTANCE—Excellent for transferring all solutions regardless of strength or composition, except hydrofluoric acid, or hot concentrated caustics. Pyrex brand piping can be recommended for all other liquids.

AVAILABILITY—Pyrex brand Pipe is available now . . . no long delays . . . no plant tie ups. You can't beat it as a low cost corrosion resistant material . . . 25 years of success back of it!



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Every process engineer should have a copy of this new detailed Pyrex Double-Tough Pipe Catalog in his file. It gives you all the information you need to lay out Pyrex Pipe Lines.

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PYREX

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A Complete Line of TEFLON STOCK



Sheets
Cylinders
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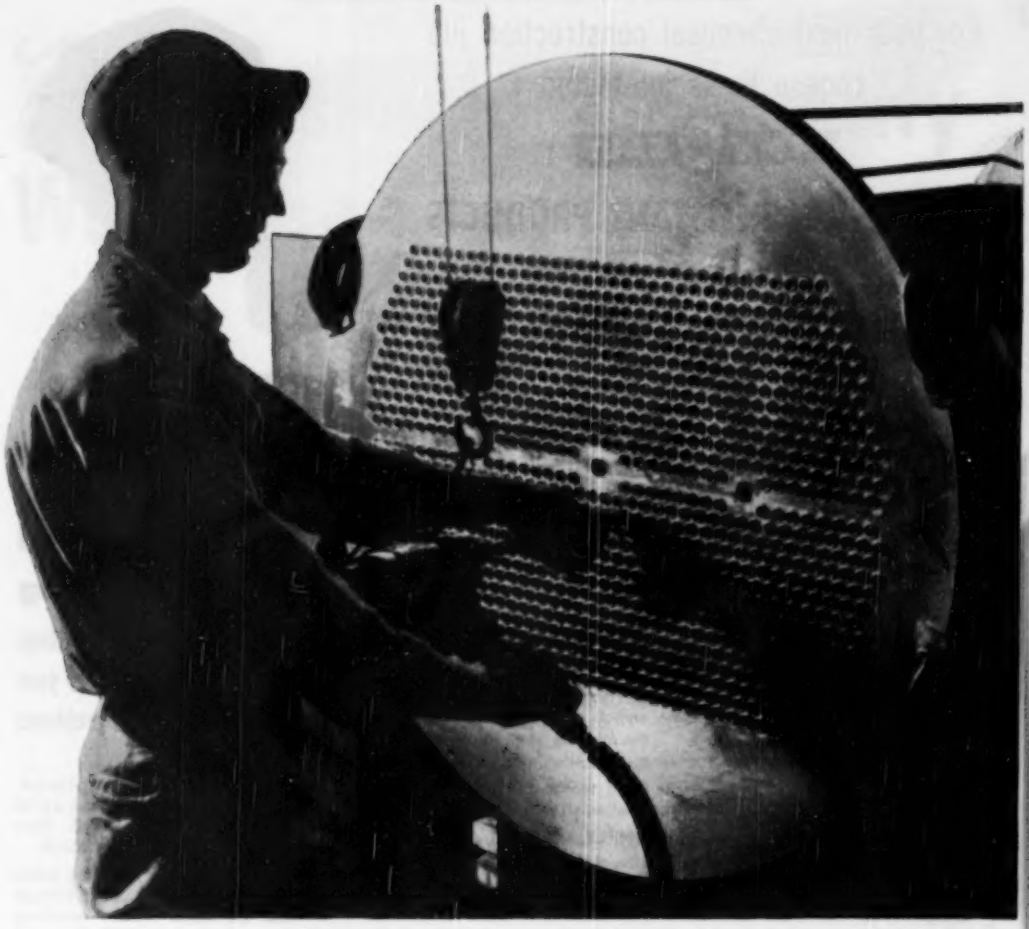
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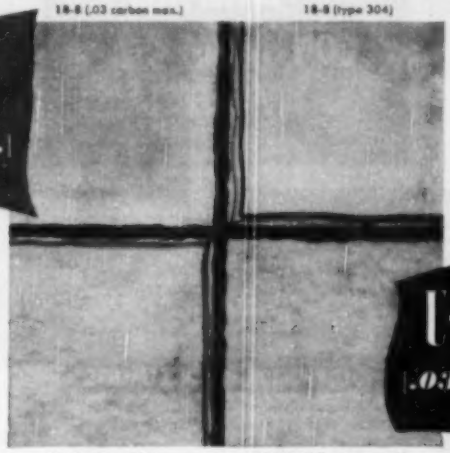
8 Attractive Colors that Apply Like Paint to Masonry, Metal, Wood

Two new extra-low carbon

U·S·S Stainless Steels

give high corrosion resistance after welding

U·S·S 18-8
[.03 carbon max.]



U·S·S 18-8 Mo
[.03 carbon max.]

This panel, composed of specimens of the four grades indicated, illustrates dramatically how low carbon grades resist corrosion after welding. The panel was exposed for 6 hours to a 10% HNO_3, 3% HF solution at 80°C. Neither of the low carbon specimens shows evidence of deterioration, while the standard 18-8 (type 304) grade is completely severed at the critical weld zone and the standard 18-8Mo (type 316) specimen is severely attacked at this point.

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Development of two new U·S·S Stainless Steels—U·S·S 18-8 [.03 carbon max.] and U·S·S 18-8 Mo [.03 carbon max.]—now makes the inconvenience of special treatment or the extra cost of stabilized grades in many applications unnecessary. In these new grades, the carbon content has been drastically reduced, practically eliminating the problem of carbide precipitation with resultant intergranular corrosion.

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By replacing stabilized grades with low carbon grades, you can realize savings in material costs up to 10%. In many cases, stress-relieving of welded vessels can be accomplished at substantially lower temperatures.

Get all the facts on these two new U·S·S Stainless Steels by writing for a copy of our booklet. Send your request to United States Steel Corporation Subsidiaries, 2204 Carnegie Building, Pittsburgh 30, Pa.

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Sulfite digesters
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Chemical polishing tanks
Bubble caps in distillation units

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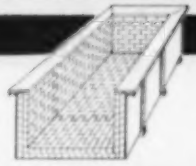
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the selection of
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CONSTRUCTION MATERIALS

CORROSION PROOF LININGS

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CORROSION PROOF CEMENTS

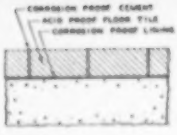
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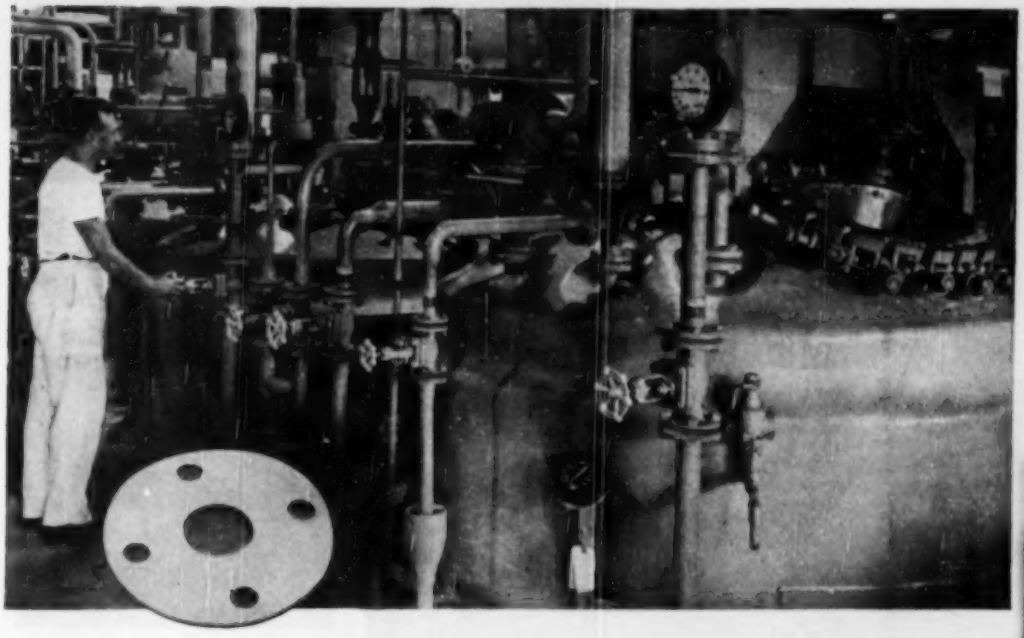
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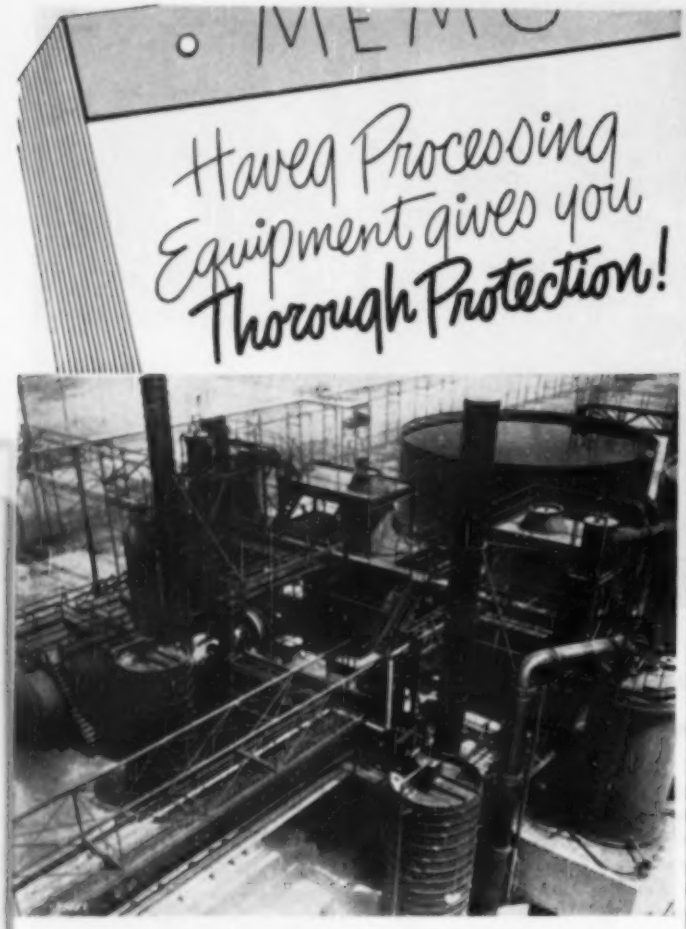
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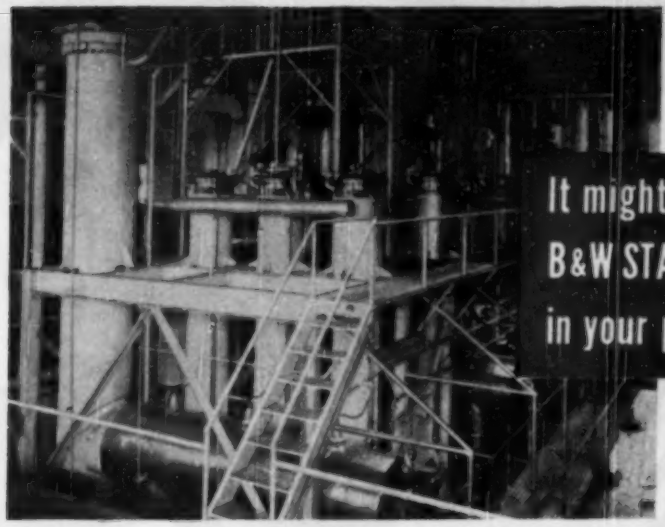
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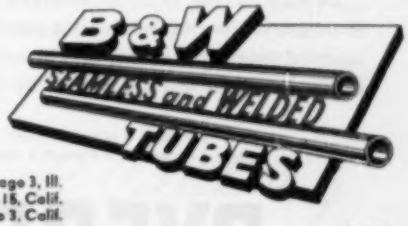
SHAPES—Round, square, rectangular, oval, and special shapes.

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Chemical Engineering
WITH CHEMICAL & METALLURGICAL ENGINEERING

NOVEMBER 1950

MATERIALS of CONSTRUCTION

PURPOSE—Today our chemical process industries have a heavy responsibility—the responsibility of helping the democratic world win its war of production against communism. It is the responsibility of producing more, of increasing productivity, of conserving materials, of keeping costs in line, of reducing waste.

Of all the enemies of efficiency in chemical plants, corrosion is the most insiduous. It is to the chemical engineer what insect pests are to the farmer—an enemy that must be fought relentlessly, with ingenuity, with the best weapons available. The problem is deciding which weapon to use.

To help answer this question—and answer it more quickly—we present this special report on materials of construction. It is the 14th in a series we began back in 1923.

CHEMICALS—You chemical engineers have to solve your problems under pressure. So we tried to make this report practical and easy to use, to capsule it as much as possible. First we divided it into 13 major sections. Each deals with a corrosive chemical. Chances are your problem is with one of these chemicals, and your first step in using this report is to turn to that section.

Do you handle corrosive chemicals that are not covered? Here's something new we're doing: we will continue this report during 1951 in our monthly Corrosion Forum department. In this way we can give you more information on more chemicals.

MATERIALS—Each chemical section has subsections on each of the major types of materials of construction. Information under these has been highly condensed. Its purpose is to answer quickly the question, "Is it used, under what general conditions and where?" We have omitted—at your request—literature references, theory, details on corrosion rates and test conditions.

This section should indicate the answers to your first question: "What materials would probably be best for my conditions?" The second major section—a comprehensive directory of manufacturers—will answer your second question: "Who makes them, and where?"

FLOWSHEETS—You will notice one other source of useful information: flowsheets of manufacturing processes. These will supplement the flowsheets that were in our 13th Materials of Construction Report, November 1948. They have been adapted from McGraw-Hill's book "Materials of Construction for Chemical Process Industries" to be published soon. Author is James A. Lee, Chemical Engineering's Southwest Editor and authority on materials of construction.

AUTHORS—This report has been made possible only by the cooperation and hard work of each of its authors. These men supplied first-hand information based on their own experience and the experience of their companies in making, selling and servicing their products to the chemical process industries. We deeply appreciate their help.

WARNING—You may find several materials which seem suited to your particular need. Yet this report is intended primarily as a time-saving guide to narrow your field of choice; your final decision should be based on relative economics, impurities (present and permissible), test performance and manufacturer's recommendations. We suggest that you: (1) use this report and those to follow in our Corrosion Forum to narrow your choice to the materials that will probably be most suitable; (2) ask the manufacturers for more details on test and installation performance; (3) if necessary, conduct your own tests.

We hope our 14th Report on Materials of Construction will prove useful to you in your fight against corrosion.

John R. Callaham

ACETIC ACID

ALUMINUM

Long used for production of acetic acid, acetic anhydride, and products in whose manufacture acetic is employed. For example: Used for storage tanks, stills, condensers, piping, valves and fittings in acetic manufacture. Used for storage tanks, acetylators, precipitators and centrifugal extractors in production of cellulose acetate.

At room temperature, corrosion rate is around 1 mil per yr. regardless of concentration. At 122 deg. F. it is substantially higher, but drops as concentration increases (10 mils per year in 1 percent acid, 8 mils in 20 percent, 7 mils in 60 percent, 3 mils in 90 percent). In glacial acetic, corrosion is low at all temperatures, rising from 0.5 mils per yr. at 77 deg. F. to only 5 mils at atmospheric boiling point.

—Ellis D. Verink, Jr.

CARBON

Carbon, graphite and certain grades of Karbate impervious carbon and graphite have been found satisfactory and chemically resistant by laboratory tests and commercial applications to all concentrations of acetic acid at temperatures up to boiling. Some services were in mixture of acetic and hydrobromic, hydrochloric or sulphuric.

Porous carbon used as diffuser medium, and Karbate as pipe and fittings, handling mixtures of steam, formic and acetic acids in agers in textile industry.

Graphite-base Karbate used under varying conditions for plate heaters, bayonet heaters, shell-and-tube evaporators and condensers, centrifugal pumps, globe valves, pipe and fittings.

Laboratory tests of Karbate in glacial and other concentrations at atmospheric boiling points showed no discoloration of acid, no change in physical appearance of the material.

For cementing Karbate products for acetic acid services, National Carbon recommends its No. 14 cement, not its No. 8.

—E. S. Malkin

CHLORIMETS

Chlorimet 3 has good corrosion resistance to acetic acid and is the Duriron Co.'s preferred high-strength alloy for exceptionally severe conditions. Although alloy develops best resistance under oxidizing conditions, plant and laboratory tests show no appreciable corrosion in mixtures of acetic and organic compounds which are reducing in nature.

Chlorimet 2, although very resistant at all concentrations and temperatures normally encountered, is not usually suggested for acetic applications because of excellent resistance and lower cost of Chlorimet 3.

—W. D. Staley

COATINGS

Hard rubbers, both natural and synthetic, vinylidene chloride and butyl rubber are used successfully within their temperature limitations (approximately 150 deg. F.). Halogenated polyethylene, phenolic and furan laminated constructions and cements, especially if asbestos or glass reinforced, will give satisfactory protection up to 350 deg. F. for all concentrations. Silicate cements are used for all concentrations at 350 deg. F., although sulphur modification will drop their limit to 200 deg. F.

Except for temporary service or other special cases, thin film type coatings are precluded by likelihood of discontinuities in film and the very high corrosion rate of steel in acetic acid.

Strong solvent action makes many organic coating materials unsuitable, namely: vinyl chloroacetate copolymers (or any material containing acetate radical), polyethylene (which allows acetic acid to diffuse through it without noticeable change in appearance or properties), soft natural and synthetic rubbers, cellulose derivatives, nylons, polyvinyl alcohols and bitumens.

—Kenneth Tator

DURIMET 20

Usefully resistant to both pure and crude acetic acid in all concentrations at temperatures normally encountered and under reducing as well as oxidizing conditions. Superior to standard stainless steels for higher concentrations and temperatures, where standard stainless sometimes shows borderline passivity. Temperature limit is

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Chemical Engineering extends its thanks to all of the 43 authors who contributed to this report. Their names and affiliations are listed below. In most cases, each author has been in a position to speak for a class of materials, rather than for his company's product alone. In some cases, his company is the sole manufacturer of the material under discussion.

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not known definitely, but has been found unsuitable for strong acid at temperature over 300 deg. F. and pressure over 150 psi.

Laboratory corrosion data on boiling acid: 0.08 mils per yr. in 10 percent acid, 0.20 mils in 50 percent acid, 0.08 mils in 75 percent, 0.10 mils in glacial.

Typical applications: Pumps handling 20 percent acetic with 3-5 percent sulphuric at room temperature. Pumps handling glacial containing less than 0.5 percent each of sulphuric and sodium bichromate at 80 deg. F. Plug valves handling 10 percent acetic plus mercury salts at atmospheric temperatures. Valves handling crude acetic with some formic at 200 deg. F. (in good condition after eight months where standard stainless had failed in about three weeks). Valves, fittings, hose connections, gage glass fittings exposed to strong vinegar at room temperatures. —W. D. Staley

DURIRON

Not limited by temperature, concentration, purity of acid or aeration.

In production and purification of acetic from wood, Duriron pipe, fittings, pumps and valves are used. Typical service conditions: concentrations up to 80 percent at 150-160 deg. F., up to 99 percent at 140 deg. F., mixture of 30 percent acetic and 70 percent propionic at 150-160 deg. F., mixture of acetic and ether at 220 deg. F., and 50-75 percent acetic at 280 deg. F. At latter high temperatures Duriron pumps should be warmed before start-up to prevent possible damage from heat shock.

In manufacture of acetic from acetylene, used for kettles for preparing mercurous sulphate catalyst, piping for handling catalyst, towers where acetaldehyde is made, valves handling 90 percent to glacial acid at boiling point.

Other applications: In manufacture of acetate rayon. Steam ejectors vaporizing acetic acid for agers in textile mills. Valves for bottling C.P. acetic for photographic work, where iron pickup is intolerable. Pumps, valves, pipe and fittings handling vinegar and mixtures of vinegar and salt (many installations in service over 20 yr. still in good condition). —W. D. Staley

GLASS LINING

Chemical durability is excellent. All concentrations of acetic acid may be stored at room temperature; corrosion rates in the order of 0.01 mils per yr. have been determined at room temperature for concentrations from 2 percent through glacial and acetic anhydride. At boiling temperature, corrosion rate is higher—0.46 mils per yr. in 5 percent acid, 0.24 mils in 40 percent, 0.08 mils in glacial. Even so, life expectancy, based on minimum cover glass thickness of 27 mils, is excellent.

Standard glass-lined steel equipment used for chlorination, esterification and sulphonation of acetic acid.

—O. I. Chormann

IRON & STEEL

Cast iron and carbon steel are not recommended for use in acetic acid services. —Albert W. Spitz

LEAD

Very limited application. Not recommended for either dilute or glacial where there is agitation, aeration or high temperature. This rules out lead except as storage medium where there is no agitation to remove lead acetate.

Lead-lined tanks and vats have been used to store glacial; service satisfactory provided tanks closed to exclude air and contents not changed frequently (changing contents renews air supply). —H. M. Church

NICKEL & ALLOYS

Monel has good resistance (2-4 mils per yr.) to all concentrations of unaerated acid, including glacial, at room temperature. Aeration increases corrosion rate, most active concentration being around 50 percent. So long as unaerated, higher temperatures, including boiling, increase corrosion only moderately. But hot aerated solutions likely to be severely corrosive.

Nickel also resistant to unaerated solutions of all concentrations at room temperature. But corrosion usually increased by aeration and higher temperature to a greater extent than Monel.

Inconel is fully resistant to dilute acid under most conditions of aeration and temperature, but is not resistant to strong hot solutions, as in concentrating stills.

Austenitic cast nickel-iron alloys, Ni-Resists Type 1 (14 Ni, 6 Cu) and Type 2 (20 Ni), usually confined to unaerated solutions at room temperature. May be used at elevated temperatures in dilute solutions. Type 1, because of copper content, is usually somewhat more resistant than Type 2.

Monel used for reactors, heating coils, piping, agitators, etc., in esterification and acetylation reactions, particularly where a little sulphuric is present. Monel also used to handle pyroligneous liquors from wood distillation. Monel and Inconel used for dyeing machines, print ager covers, rolls, shafts, piping, etc., in textile processes involving acetic acid. Monel, nickel and Inconel all widely used in food industry in connection with fermentation and vinegar.

—W. Z. Friend

RUBBER LINING

Can be compounded to handle all concentrations of acetic acid for service up to 120 deg. F. Laboratory studies and limited commercial use suggest rubber could be used more than it is for lining tanks, pipe, fittings and valves.

Semi-hard and hard compounds are resistant to all concentrations, including glacial and anhydride. Acetic acid is quite soluble in soft compounds of all the rubbers, although specific soft compounds of natural or GR-S can be made which will resist low concentrations at atmospheric temperatures.

All rubber compounds impart varying degrees of color to acetic acid, color extraction increasing with concentration and temperature of the acid. For water white acid, special compounds are available which in a commercial installation will not impart sufficient color to be visible to the naked eye. —O. S. True

SILICONES

Greases—Used in service lines handling acetic acid and acetanilide. Valve grease has improved life and performance of valves handling acetic at

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temperatures from 21 to 200 deg. F.

Elastomers—Laboratory evaluation based on changes in volume, weight, elasticity, hardness and appearance indicate most silicone rubbers are resistant to both aqueous and 100 percent acid at room temperature. No specific data are available for higher temperature.

Resins—In laboratory evaluation at room temperature silicone resins showed good resistance to aqueous acid, poor resistance to concentrated acid.

In a test on pigmented films, a silicone coating resin pigmented with titanium dioxide was half immersed in 3 and 20 percent acetic acid at 70 and 100 deg. F. and after 8 hr. exposure gave no indication of film deterioration. —J. A. McHard

Leon Van Volkinburg

STAINLESS STEEL

Widely used for all concentrations, including glacial, and temperatures up to the boiling point.

In manufacture of acetic acid, stainless is used for stills, columns, bubble caps and trays, pipelines, storage tanks. Types 304 and 308 are usually chosen for 100-percent vapors, the liquid acid, and solutions—Types 316 and 317, with their pitting resistance, being best for dilute vapors, high temperatures, and pressure above atmospheric.

In processing rayon and acetate textiles, stainless is used for tanks, spinnerettes, other equipment. Types 304 and 308 used most; 316 frequently selected for high temperature.

In food industry, Type 304 widely used, highly satisfactory except some cases where presence of salt causes pitting; however, 316 is often suitable for brines containing acetic, sugar and salt.

In photographic processing, engraving and lithography, Type 316 is best. Used for tanks and trays for developing, fixing, stopping; both color and black-and-white.

—Grant L. Snair, Jr.

STONEWARE

Completely inert at all concentrations at all temperatures at which stoneware is commonly employed. More widespread use curtailed only by comparatively high first cost.

Used in vinegar plants for piping, pumps, cooling and condensing coils, and generators in which ethyl alcohol is fermented to acetic acid. Used in concentration of dilute acid for distillation columns, piping, fittings, cocks, pumps. Used for acetic vapor exhausters, vapor absorption and reaction towers, boiling kettles, nutsche filters. —F. E. Herstein

TANTALUM

Tests and service records show no attack at any concentration up to 175 deg. C.; above this temperature the effect, if any, is unknown. Since other materials are sufficiently resistant under mild conditions, tantalum is recommended only for severe services and for heat transfer surfaces. Contaminants commonly found in acetic acid have no effect.

Tantalum condenser has been in service six years in distillation of acetic from wood under conditions where other condenser materials quickly failed. Heaters used for heating crude acid for distillation into pure acid; tantalum not necessary for condensers in this case. —F. L. Hunter

WORTHITE

Many hundreds of pumps and valves in great variety of services involving acetic acid. Claimed preferable to standard stainless for higher concentrations at high temperatures, or where purity of product is important, or where acetic contains sulphuric.

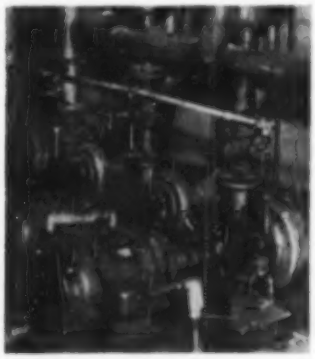
Laboratory tests and field reports indicate negligible corrosion under the following conditions: 5 to 99.5 percent at 176 deg. F. Pumps handling hot solutions, glacial and anhydride. Pumps partially submerged in 5 to 99.8 percent solutions. Pumps partially submerged in 98 percent acetic plus 1 percent formic and 5 percent propionic, butyric and crotonic acids.

Field tests in 12 percent pyroligneous liquor showed corrosion rates of 0.1 mils per year at 335 deg. F. in distillation equipment, 0.3 mils at 275 deg. F. in steamer, 2.3 and 11 mils at 335 deg. F. in autoclave where 10 percent sulphuric was present.

Some mixtures being handled by Worthite pumps: 85 percent acetic plus solvent at 215 deg. F.; 27 percent acetic plus 1.5 percent sulphuric; 30 percent acetic and 70 percent nitric; vinegar-salt pickle brine; acetic plus salt brine at 150 deg. F. in synthetic rubber manufacture.

Worthite pumps used for the various temperatures and concentrations of acetic acid commonly found in the following fields: manufacture of the acid, acetate rayon, fine chemicals, pharmaceuticals, dyestuffs, food products, chemical warfare (except a mixture containing 3 percent chlorine), industrial alcohol manufacture, photographic including color, plastics, solvents, synthetic rubber and magnesium pickling. —W. E. Pratt

Materials at Work:



WORTHITE vs. ALCOHOL
Worthite pumps handling evaporator discharge in a distillery.

AMMONIA

ALUMINUM

Thin protective oxide film forms after exposure to ammonia and prevents further appreciable attack.

Typical uses: Ammonia refrigeration tubing. Storage vessels, sprays, and molds, in contact with ammoniacal rubber latex. Tubing handling ammonia—CO_2—steam mixtures under condensing conditions (ammonia recovery systems in soda ash industry). Bubble cap towers for ammonia recovery in byproduct coke plants, exposed to hot ammoniacal sulphide bearing liquors. (H_2S and CO_2 actually inhibit ammonia-steam mixtures under condensing conditions. Aluminum heat exchanger tubes are satisfactory for ammonia-steam mixtures containing at least 1 part CO_2 for every 2¼ parts NH_3.) Aluminum equipment also widely used in contact with ammonium bicarbonate, ammonium carbamate, urea, ammonium nitrate and ammoniated ammonium nitrate (over 500 aluminum tank cars for ammoniated ammonium nitrate).

—Ellis D. Verink, Jr.

CARBON

Ammonia, in all its forms, has no effect on carbon, graphite or Karbate impervious carbon and graphite. Karbate is satisfactory for solutions of all

concentrations to the boiling point. In pure ammonia, under reducing conditions, carbon and graphite are thermally stable and withstand temperatures to 3,600 deg. C., their volatilization temperature. When air is present perceptible oxidation of carbon occurs at 350 deg. C., of graphite at 400 deg. C. —W. W. PALMQUIST

CHLORIMETS

Good resistance to aqueous and anhydrous ammonia but little used because less expensive alloys are satisfactory. Become economical only when service is very severe, as with ammonium salts in presence of hydrochloric acid. Chlorimet 3, for instance, satisfactorily handles hot ammonium chloride solutions containing sodium chloride and hydrochloric acid. For such services, Chlorimet 3 will be preferred in most cases to Chlorimet 2 since the latter is chrome-free and not resistant to nitrates, sulphates and other oxidizing salts.

—WALTER A. LUCE

COATINGS

The vinyl copolymers, the phenolics and furans, polyethylene or its halogenated modifications, and all of the natural and synthetic rubbers, both hard and soft, except thiokol, are suitable within their temperature limitations for handling ammonia either as wet or dry gas, as liquid or as aqueous solution. Vinylidene chloride polymers, sulphur cements, thiokols, and bituminous compositions should be used only after specific test, if at all.

Because ammonia is not seriously corrosive to steel, organic coatings are generally justified only to prevent metallic contamination. And also because of low corrosion rate, thin film coatings are suitable, since inadvertent discontinuities will result neither in corrosion damage to equipment nor perceptible metallic pick-up by the product.

Under pressure, some organics absorb small amounts of ammonia, not enough to hurt its protective quality, but sudden pressure release and expansion of the dissolved ammonia may sometimes cause defects in the bond and even gradual destruction of the coating. If pressure is released slowly, the ammonia diffuses out without incident. Thin films are less susceptible than thick. —KENNETH TATOR

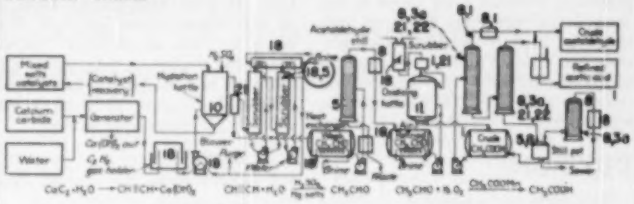
DURIMET 20

Resistant to ammonia in all its various forms, but generally used only for acid ammonium salts, since less expensive materials are satisfactory for straight ammonia or alkaline salt solutions.

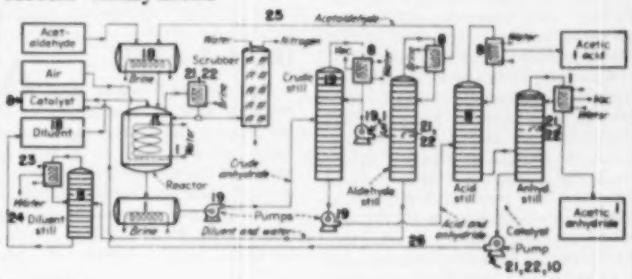
Used to handle ammonium nitrate and diammonium phosphate; tested and found suitable for ammonium fluosilicate.

Finds particular application in production of ammonium sulphate, where temperatures go up to 220 deg. F. and sulphuric acid concentrations reach 12 percent. Under these high temperature conditions Durimet's corrosion rate is about 7 mils per yr., while that of

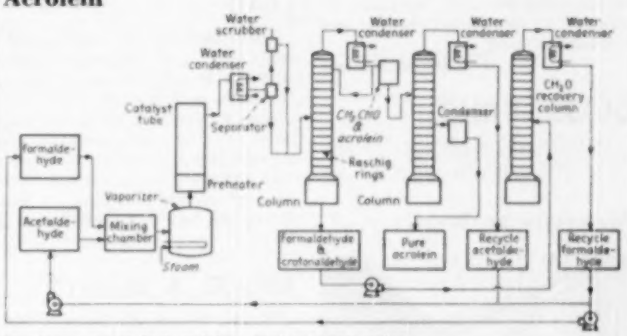
Acetic Acid



Acetic Anhydride



Aerolein



Aluminum except 18-8 stainless steel catalysis tubes.

Key: Materials of Construction

1. Aluminum	11. Impervious Graphite	21. Type 316
2. Brick	12. Iron	22. Type 317
3. Bronze	13. Lead	23. Type 347
4. Carbon Steel	14. Monel	24. Type 430
5. Cast Iron	15. Nickel	25. Stoneware
6. Chemical Lead	16. Rubber	26. Tile
7. Concrete	17. Silica	27. Tygon
8. Copper	18. Steel	28. Wood
9. Glass	19. Stainless Steel	
10. High Silicon Iron	20. Type 304	

a = alloys; l = linings (with steel backing in almost all cases); r = refractory lined; O materials used in combination; two numbers: either material may be used.

conventional 18-8SMo (Type 316) goes as high as 45 mils. At lower temperatures, Durimet's rate drops to less than 1 mil per year. However, ammonium sulphate crystals in suspension can erode Durimet or standard stainless drastically and an abrasion resistant alloy like Duriron may be much better. —Walter A. Luce

DURIRON

Resistant to anhydrous gas and liquid but rarely used because stronger and less expensive materials are satisfactory. Not recommended for ammonium hydroxide solutions or alkaline ammonium salt solutions.

Good service in acid ammonium salt solutions. Examples: Pumps, valves and pipe in fertilizer plant handling highly erosive slurry of ammonium sulphate crystals in solution of ammonium sulphate and sulphuric acid; corrosion rate is about 5 mils per yr. but it withstands erosion that quickly destroyed lead, standard stainless steel and a special high-alloy stainless steel. Duriron also used for ammonium nitrate solutions and Durichlor for mixtures of ammonium chloride and hydrochloric acid.

—Walter A. Luce

GLASS LINING

Not normally called upon to handle gaseous ammonia, wet or dry, nor the compressed liquid. Ammonia solutions used occasionally for neutralization. At room temperature ammonia in any concentration has little effect on glass; but at elevated temperatures and pressures, with water present, glass in vapor phase is quite rapidly etched. Laboratory tests on a glass suitable for severe acid service:

In Vapor Phase	
5% NH_4OH at 185 deg. F.	20.4 mils per yr.
10% NH_4OH at 212 deg. F.	12.3 mils per yr.
In Liquid Phase	
5% NH_4OH at 185 deg. F.	2.3 mils per yr.
10% NH_4OH at 212 deg. F.	3.6 mils per yr.

—S. W. McCann

IRON & STEEL

Cast iron and carbon steel are extensively used to handle dry or wet gas, liquid, and aqueous solutions. Some corrosion may occur with ammonia solutions and wet vapors, requiring more resistant materials for valve trim and pumps, or for cases where iron contamination must be avoided. —Albert W. Spitz

LEAD

Unaffected by dry ammonia gas or anhydrous liquid. Ammonia vapor or ammonia in solution can be used satisfactorily with lead at practically all concentrations and up to the boiling point. Valves and piping, when screwed fittings are used, are made up with litharge-glycerine cement. Metallic lead gaskets are used on flange fittings for handling ammonia in any form. —Kempton H. Roll

NICKEL & ALLOYS

Nickel, Monel and Inconel highly resistant to dry ammonia even at high temperature. All three used in ammonia refrigeration. Inconel in particular is used for cracking ammonia and for nitriding equipment operating around 1,100 deg. F. Tests in nitriding equipment show attack of only 0.35 mils per 100 hr. for Inconel. Nickel and low-Mn Monel also are usefully resistant but not like Inconel.

Nickel unaffected by ammonia-air mixtures in ammonia-oxidation process; used for pipe carrying the mixed gases to converter, for connections to converter and for platinum support.

None of these alloys resists mixtures of nitrogen, hydrogen and ammonia under the high pressure conditions of ammonia synthesis.

In ammonium hydroxide solutions Monel is only resistant below 3 percent at room temperature, nickel below 1.5 percent at room temperature. Inconel is resistant to all concentrations of ammonium hydroxide and is used for equipment in some organic ammoniation reactions.

—W. Z. Friend

RUBBER LINING

Wet ammonia gas and ammonia solutions can be handled with hard rubber linings. Soft rubber should not be used due to possibility of diffusion through lining and breaking the rubber-to-metal bond. For cases requiring abrasion resistance of soft rubber, layer of hard rubber can be placed under the soft to stop diffusion by ammonia.

Rubber linings should not be used in contact with dry ammonia gas or the compressed liquid.

—J. P. McNamee

SILICONES

Greases—Silicone valve lubricants used successfully in services handling liquid ammonia at high and low temperatures. Has also given good service with ammonium chromate at high temperatures, with amines such as aniline oil at temperatures ranging from 20 deg. C. to 200 deg. C., and with copper ammonium solutions.

Elastomers—Laboratory tests at room temperature indicate good resistance to liquid ammonia and to 10 percent and concentrated ammonium hydroxide, suggesting usefulness as gaskets and seals in ammonia refrigerating systems. Test data confirmed in part by use of Silastic to increase service life of nickel safety disks in contact with ammonia vapors from 3 days to 3 months.

Resins—Laboratory tests at room temperature on representative silicone resins indicate fairly good resistance to liquid ammonia, good resistance to 10 percent and concentrated ammonium hydroxide. This suggests usefulness of certain resins for protective coatings. —J. A. McHard

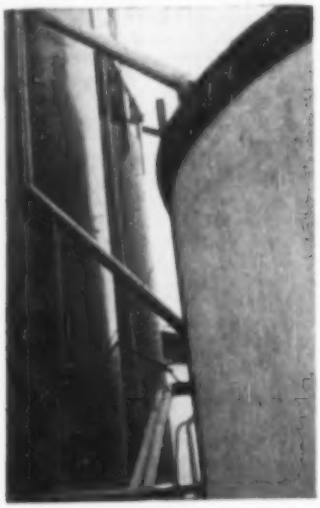
Leon Van Volkinburg

STAINLESS STEEL

Chrome-nickel types unaffected by ammonia solutions or moist gas. All types resist anhydrous liquid and dry gas below decomposition temperature. Stainless can be nitrided by dissociated ammonia under controlled conditions, but is practically unaffected at most temperatures.

Typical applications: Handling gases and liquors in ammonia production by both synthetic and byproduct coke processes. Throughout ammonia oxidation process handling ammonia and nitric acid. Converters handling am-

Materials at Work:



RUBBER vs. CHLORINE
Chlorine tanks lined with rubber to prevent corrosion.

monia under pressure at high temperatures. Pipes, coils, compressors and evaporators in refrigeration systems. Storage tanks, mixing kettles, circulating systems, heat exchangers and numerous other kinds of equipment used in the manufacture of fertilizers, pharmaceuticals, explosives, treated fabrics, plastics, rubber, petroleum and countless others in which ammonia plays a part. —Grant L. Snair, Jr.

STONEWARE

Inert at concentrations and temperatures normally encountered. Used for pipes, pumps and vessels—but only where other more corrosive chemicals are also present, particularly hydrochloric acid—and where product purity is an issue. —F. E. Herstein

TANTALUM

Inert to wet gas, compressed liquid, solutions. With dry gas embrittlement has been reported under conditions of high pressure and temperature.

Not considered necessary with ammonia or ammonium hydroxide alone, but is useful when chlorine or bromine is also present. For example, high purity ammonium chloride is made in tantalum equipment.

—Leonard R. Scribner

WORTHITE

Resistant to ammonia gas up to nitriding temperature but its use instead of steel is not economical. Pumps used in byproduct coke plants for ammonia liquor (gas liquor), which contains corrosive impurities. Several hundred Worthite pumps used in plants making ammonium sulphate from byproduct or synthetic ammonia.

—W. E. Pratt

CAUSTIC SODA

ALUMINUM

Severely corroded by any appreciable concentration. At room temperature rate is about 0.7 mils per yr. in 0.0001N NaOH and about 1,670 mils per yr. in 0.1N solution.

—Ellis D. Verink, Jr.

CARBON

Carbon, graphite and Karbate impervious carbon and graphite (Grades 11 and 21) are inert to caustic soda at all concentrations and all temperatures, except impervious forms not recommended for service above 340 deg. F. Some applications:

Alkaline scrubbing towers, many handling boiling concentrated caustic soda, are usually packed with carbon rings, frequently lined with carbon brick and fitted with carbon or graphite distributor plates, packing support grids and other accessories.

Process towers alternately handling strong caustic and strong acid frequently have graphite bubble caps and trays, and carbon brick and graphite slab lining.

Carbon brick very extensively used for brick lined tanks and digesters in caustic service.

Karbate heat exchangers, pumps, piping, valves, etc. used in chemical, rayon and textile industries where metallic and siliceous contamination is undesirable. Karbate heat exchangers used in sodium hypochlorite production to cool both caustic and hypochlorite. —R. O. Joslyn

CHLORIMETS

Chlorimets 2 and 3 show excellent resistance to all concentrations up to 80 percent at temperatures up to normal boiling point, with a temperature limit of 400 deg. F. for the higher concentrations. Cost more than other caustic resisting alloys (Durimet, Worthite, nickel, nickel alloys and others), but used occasionally where other corrosives as well as caustic must be resisted. Examples of this: Chlorimet 3 used to handle caustic during continuous introduction of chlorine to make sodium hypochlorite bleach. Another case where manufacturer wanted complete interchangeability of many pumps in many services, including caustic handling. And another where pump handled caustic and various acids alternately.

—Walter A. Luce

COATINGS

In successful use are natural and synthetic rubbers, vinyls, furans, methacrylates, polystyrene, Saran, polyethylene, and the nylons. Phenolics are not recommended. Furans may be used up to and often over 275 deg. F.; neoprenes up to 220 deg. F.; others up to about 180 deg. F. Where first coat is predominant factor, force-dried vinyl coatings are in considerable use. Because durability of coating depends on thickness and resilience, rubber coatings 1/64 to 1/32 in. thick are commonly recommended. From standpoint of cost, durability and performance the author favors a spray coating of neoprene rubber 1/64 in. thick.

Steel is not rapidly corroded by caustic within temperature limits of organic coatings. Therefore coatings are normally used only where product contamination is the issue. Therefore also, thin films are satisfactory because slight discontinuities from imperfect application or subsequent injury will not result in serious equipment damage or perceptible contamination of product. If coating is used to prevent attack on a caustic-corrodible material like aluminum, coating should be at least 1/8 in. thick and resilient enough to withstand normal impact and abrasion; rubber linings are good.

It is important that coatings, especially vinyl and rubber, be compounded with materials not reactive with caustic. Latex systems are likely to have emulsifying or stabilizing agents susceptible to caustic action.

—Kenneth Tator

DURIMET 20

Present data indicate satisfactory resistance up to approximately 75 percent at normal boiling temperatures, and to about 300 deg. F. for concentrations above 75 percent.

Laboratory tests on Durimet 20 in 80 percent sodium hydroxide at 230 deg. F. showed no weight loss after ten days' exposure.

Plant test of many weeks duration in 75 percent caustic at about 200 deg. F. showed corrosion rate much less than 1 mil per yr.

Alkali plant reports no corrosion trouble from numerous Durimet valves handling 10 to 50 percent caustic at 150 to 212 deg. F.

—Walter A. Luce

DURIRON

Restricted application. Low and acceptable corrosion rates at low concentrations and moderate temperatures but not superior to cast iron in resistance to caustic alone. Finds some application, however, where presence of other corrosives precludes cast iron. Examples of this:

Alkali manufacturer uses Duriron pumps to recirculate cold caustic soda to absorb waste chlorine gas. High-silicon irons, Duriron and Durichlor, widely used in manufacture of sodium hypochlorite bleach, show good re-

sistance to caustic soda, chlorine and hypochlorite at ambient temperatures necessary for stable bleach manufacture; many of these installations are made almost entirely from high-silicon iron—pumps, valves, pipe, heat exchangers, for cooling, tank outlets and ejectors for chlorine introduction.

—Walter A. Luce

GLASS LINING

Not usually recommended. However question comes up when user wants to subject existing equipment to caustic solutions. Can sometimes be done, depending on temperature. Action is very slow at room temperature, fast at higher temperatures. Concentration is much less important. If doubtful ask manufacturer. Laboratory data show:

	Rate of Attack, Mils per Yr.		
	Solution at 70 Deg. F.	Solution at 130 Deg. F.	Solution at 210 Deg. F.
1% NaOH	0.167	2.62	17.42
5% NaOH	0.197	14.78	48.22
10% NaOH	0.312	18.06	100.20
20% NaOH	0.232	20.30	79.20

New glass compositions, still in experimental stage, promise three times the resistance of above-tested glass to hot alkaline solutions.

—S. W. McCann

IRON & STEEL

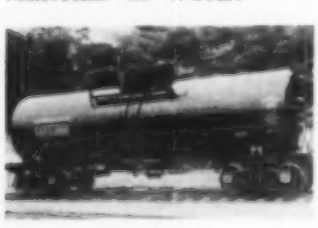
Extensively used where slight iron contamination not objectionable. Corrosion rates increase with concentration and temperature, approximate limits for economical operation being 100 deg. C. and 75 percent. Storage tanks for caustic soda solutions should have ample wall thickness, one leading manufacturer suggesting ½ in. flange quality steel.

Tanks may be fusion welded if properly stress relieved or riveted and caulked inside and out. Tests have shown that danger of stress-corrosion cracking of steel exists in zone bounded by concentrations of 15 and 43 percent and temperatures above 180 deg. F.

All-iron pumps, valves and cocks may be used. Use of more resistant alloys for pumps and valves operating at the higher temperatures and concentrations is usually worth the additional cost.

—Albert W. Spitz

Materials at Work:



NICKEL vs. CAUSTIC SODA
Nickel-clad steel tank car used for transporting rayon-grade caustic.

LEAD

Reacts with caustic soda solutions to form plumbites, which are soluble and cannot provide protective surface film. Corrosion rates are tolerable, however, for some purposes and under certain conditions. For example, in petroleum refining where a sulphuric acid treatment is followed by an alkaline solution treatment in same lead-lined tank.

Laboratory test, 25 percent NaOH at various temperatures:

Temperature, Deg. C.	Corrosion Rate, Mils Per Yr.
10	4.8
20	4.8
40	2.4
60	6.0
80	5.4
100	16.8

Laboratory test, various concentrations and temperatures:

	Corrosion Rates, Mils Per Yr.	
	20 Deg. C.	100 Deg. C.
5% NaOH	12.2	42
25% NaOH	4.8	12
35% NaOH	3.6	6

Laboratory test, effects of aeration, 1 N solution:

Total Immersion	Corrosion Rate, Mils Per Yr.
Quiet	10
Air-agitated	40
Alternate Immersion	
Continuous	600
Intermittent	280
Spray (30 days)	1

—Kempton H. Roll

NICKEL & ALLOYS

Nickel is highly satisfactory material for practically all concentrations and temperatures. It confers on Monel and Inconel resistance of the same order as its own, and it greatly improves caustic resistance of cast iron and steel.

Nickel and nickel-clad steel are standard for evaporators concentrating sodium and potassium hydroxides to 50 and 70 percent. Storage tanks for 50 and 70 percent caustic and tank cars for 75 percent caustic are made of nickel-clad steel. Nickel pumps, valves and piping used for hot 70 percent solutions. Ni-Resist alloys (nickel cast irons) used extensively for pumps, valves and other equipment handling hot caustic solutions up to 50 percent and sometimes higher. These test data show clearly the high degree of caustic resistance possessed and imparted by nickel:

Plant test in evaporator concentrating caustic soda to 50 percent. Duration 38 days.

	Corrosion Rates, Mils Per Yr.
Nickel	0.1
Inconel	0.3
Ni-Resist (Type 1)	4
Ni-Resist (Type 2)	2.6
Nickel cast iron (3% Ni)	9
Cast iron	22

Laboratory tests in caustic soda being concentrated from 60 to 75 percent. Temp. 300–350 F.

Monel	4.7
Nickel	1.0

Plant test in 75 percent caustic receiving tank. Temp. 275 F.

Nickel	1.6
Monel	1.7
Inconel	1.3
Ni-Resist (Type 1)	4
Cast iron	73
Mild steel	71

Effect of nickel in cast irons. In 50-65 percent caustic soda boiling under vacuum of 26 in. Hg.

0	73
0	91
0	86
3.5	47
5	49
15	30
20	3.3
20 (+2% Cr)	6.0
20	0.4

Low-carbon nickel and low carbon nickel-clad steel successfully used in production of anhydrous caustic soda and potash by continuous evaporation, where chlorate content of caustic is very low. Inconel also used for evaporating tubes in production of high strength caustic where contamination of solution by small amount of chromium is not objectionable. Both low-carbon nickel and Inconel used as reactors for organic caustic fusions, Inconel being preferred where sulphur compounds are present. Inconel equipment must be stress-relieved before use in any of these high temperature caustic applications.

—W. Z. Friend

RUBBER LINING

Suitable for all concentrations. For temperatures below 150 deg. F., soft natural rubber stocks may be used. For temperatures above 150 deg. F. to boiling, hard natural rubber is satisfactory. Soft neoprene linings are excellent for very strong (70 percent) caustic solutions at intermittent temperatures as high as 230 deg. F.

Used to line storage tanks, process vessels, pipe and fittings in great variety of services. Special linings available for severely abrasive conditions with either weak or strong caustic solutions.

—E. L. Lockman

SILICONES

Rubbers—Two corrosion resistant rubbers, Silastics 180 and 181, and a higher strength rubber, Silastic 250,

were tested in 10 and 50 percent NaOH at 25 and 100 deg. C. All showed good resistance to both concentrations at 25 deg. C. At 100 deg. C. none showed good resistance to the 50 percent solution and only Silastic 250 showed good resistance to the 10 percent.

Resins—Five silicone resins, tested under the same conditions as the rubber, all showed good resistance at 25 deg. C. to both 10 and 25 percent NaOH. At 100 deg. C. all were disintegrated by the 50 percent solution and in the 10 percent solution three were rated good, one fair, and one poor.

Greases and fluids—In a laboratory test, three silicone fluids, at 25 deg. C., all showed good resistance to 10 percent NaOH and poor resistance to 50 percent NaOH. In service, silicone greases and compounds are giving good performance in a wide variety of exposures to NaOH—on the packing glands of hot-caustic pumps, for instance. —W. J. HARGREAVES
FRANCES HENSON

STAINLESS STEEL

Useful primarily for moderate concentrations and temperatures. Cnrome-nickel grades widely used under these conditions for such things as soap processing kettles, soda pulp equipment, and such viscose rayon equipment as steep tanks and mixers.

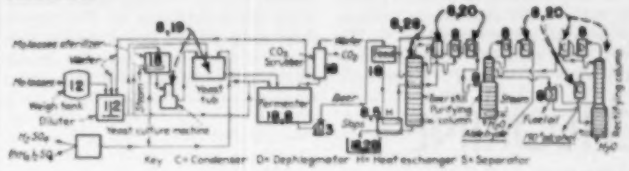
Straight chrome grades, Types 410 and 430, useful for low concentrations and temperatures, as for storage, but are generally not as suitable as chrome-nickel grades. Types 304 and 316 show good resistance to boiling caustic soda up to 10 percent, but above this concentration, temperature limit probably would not exceed 200 deg. F. Types 304 and 316 suffer practically no corrosion by concentrations up to 50 percent at temperatures up to boiling, and would have good life under such conditions, but formation of a sludge on the metal surface in some instances would be likely to discolor the sodium hydroxide. When stainless is used, Type 304 is generally selected, since 316 offers no great improvement in caustic resistance.

For fused caustic soda, stainless is no better than ordinary carbon steel and is rarely used.
—W. G. RENSHAW

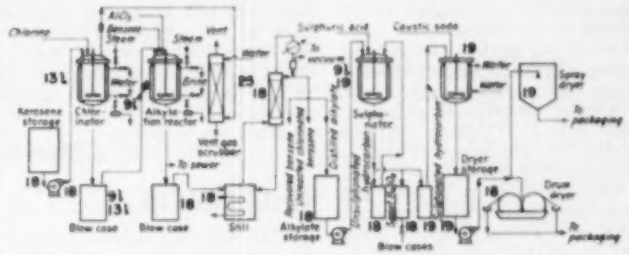
STONEWARE

Severely attacked, as are all siliceous materials, by strong hot alkali solutions. Not suitable for concentrations over 25 percent at temperatures over 80 deg. C. —F. E. HERSTEIN

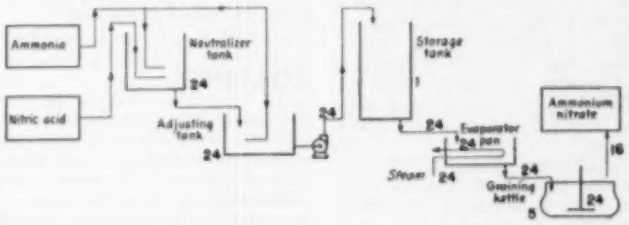
Alcohol



Alkyl Aryl Sulphonate



Ammonium Nitrate



Key: Materials of Construction

1. Aluminum	11. Impervious Graphite	21. Type 316
2. Brick	12. Iron	22. Type 317
3. Bronze	13. Lead	23. Type 347
4. Carbon Steel	14. Monel	24. Type 430
5. Cast Iron	15. Nickel	25. Stoneware
6. Chemical Lead	16. Rubber	26. Tile
7. Concrete	17. Silica	27. Tygon
8. Copper	18. Steel	28. Wood
9. Glass	19. Stainless Steel	
10. High Silicon Iron	20. Type 304	

a = alloys; l = linings (with steel backing in almost all cases); r = refractory lined; O materials used in combination; two numbers: either material may be used.

TANTALUM

Attacked by caustic soda and most other alkalis, even in weak solutions.
—ALLAN L. PERCY

WORTHITE

Many hundreds of Worthite pumps used for caustic soda solutions and caustic-salt slurries up to 50 percent NaOH at temperatures up to 250 deg. F. in the following industries: caustic manufacture, rayon, plastics, chemicals, soap, petroleum, lye manufacture, pulp and paper, textile, rubber, vegetable oil refining. At lower temperatures (194-212 deg. F.), shows very low corrosion rate (0.2 mils per yr.) at higher concentrations (73 percent).

But at high temperatures (250 + deg. F.) and high concentrations (70 + percent), data are conflicting. Examples: Test showed high corrosion rates for all chrome-nickel alloys in 73 percent caustic storage tank at 248-340 deg. F. Test in 70 percent

caustic at 300-400 deg. F. in nickel evaporator showed very low corrosion of Worthite specimen insulated from evaporator body, but severe galvanic corrosion of specimen wired to the body. No apparent corrosion over many years of Worthite pump handling 73 percent caustic at 284 deg. F. and not insulated from nickel or Monel piping. Some possible conclusions about corrosion of Worthite at high temperatures and concentrations: stagnant conditions (as in the storage tank) are more corrosive than turbulent (as in the evaporator and the pump); in contact with nickel, Worthite suffers galvanic corrosion if the nickel area is much larger (as in the evaporator) but perhaps not if the areas are more nearly equal (as with the pump). —W. E. Pratt

CHLORINE

CARBON

Carbon, graphite and Karbate impervious carbon and graphite are unattacked by dry chlorine.

Carbon and graphite linings, tubes, heating elements, crucibles, diffusers, etc. are used in reactors employing dry chlorine at temperatures as high as 3,000 deg. F. Graphite tubes are standard for introduction of chlorine into molten metal baths. Any mixture of chlorine and air can be used up to temperatures where carbon or graphite would normally show signs of oxidation in air, 625 and 800 deg. F., respectively. Karbate has similar resistance to dry chlorine except that maximum operating temperature is 340 deg. F. Karbate diffusers, heaters, coolers, condensers, piping, valves, pumps and byproduct hydrochloric acid systems are regularly used for chlorination of alcohols, acetic acid, and aliphatic and aromatic hydrocarbons.

While carbon, graphite and Karbate are not attacked by chlorine, they may be by hypochlorous acid. Attack (oxidation) is favored by any condition favoring

$Cl_2 + H_2O \rightarrow HCl + HOCl$, or

$HOCl \rightarrow HCl + O$(active).

Severe attack (3/16 in. in two yr.) has been noted in uncooled wet chlorine from cells and in chlorine saturated brine at atmospheric boiling point. But no noticeable corrosion has occurred in cold saturated chlorine water, or in 30 percent hydrochloric acid in the presence of free chlorine at temperatures up to boiling.

—L. C. Werking

Materials at Work:



SILICONES vs. CHLORINE
Silastic gaskets withstand 90-95 percent wet chlorine gas.

CHLORIMETS

Chlorimet 3 has excellent resistance to chlorine, wet or dry, and chlorine water at room temperature. Test reports indicate it to be suitable for moist chlorine up to 850 deg. F.

—J. L. Traub

COATINGS

Dry chlorine is no problem; carbon steel and most organic coatings are resistant, but moisture or water brings forth the horns. All organics not outstanding in oxidation resistance are immediately eliminated—which leaves vinyl copolymers, vinylidene chloride polymers, polyethylene and its hydrogenated derivatives, polystyrene and hard natural rubber.

Natural rubber, although not famous for oxidation resistance, is protected in this case by surface film of rubber hydrochloride. Service life over ten years is not an uncommon occurrence for pumps, piping, agitators, tanks, absorption towers and electrolytic cells handling moist or aqueous chlorine or chlorine-base bleach solutions.

Saran and vinyl chloroacetates have recently demonstrated good potentials where properly compounded against oxidation and hydrogen chloride permeability.

Polyethylene and its hydrogenated derivatives and polystyrene are extensively used in form of loose liners, diaphragms, gaskets and molded parts: promise improved coatings when dependable application techniques worked out.

In prolonged exposure some surface attack can be expected, so coatings should be as thick as economically practical—1 in. is not uncommon. Effect of thickness is well demonstrated by phenolics and furanes: 6-mil films fail rapidly, while cast or molded fittings are reported satisfactory by number of users.

—Kenneth Tator

DURIMET 20

Used to a limited extent for wet and dry chlorine gas and for chlorine solutions. Not recommended above room temperature except after specific test, although has been reported satisfactory in moist chlorine up to 900 deg. F.

Extensive tests by manufacturer of water chlorinating equipment found Durimet quite satisfactory for handling chlorine water—no visible attack up to 2,500 ppm., slight pitting under gaskets at 3,000 ppm.

Large paper mill using Durimet pipe, fittings and dispersers for chlorine water in slime control reports good service where velocities are low.

Lower cost and generally better life of high silicon irons limits Durimet pretty much to cases where nonmetallics and non-machinable alloys are undesirable. —J. L. Traub

DURIRON

High silicon irons, and particularly the one containing 3 percent Mo, Durichlor, are recommended provided hot, wet chlorine gas or mixtures of chlorine and steam are not involved. Widely applied and economically used in applications such as these:

Treating city water by mixing chlorine gas with water in silicon iron ejector: free chlorine content of water 0.3-0.4 percent; ejector life 2½ to 10 yr. depending on water temperature, velocity, suspended solids.

Ejectors, pipe, fittings and distributor heads operating under similar conditions in paper mill slime control.

Ejectors, pipe, valves and fittings handling supersatuated chlorine water (as high as 100 g. Cl per liter of water) for paper pulp bleaching. Also, pumps handling chlorinated pulp.

Equipment for introducing chlorine into brines, into hydroxides for producing hypochlorites, into organics for producing chlorinated hydrocarbons.

—J. L. Traub

GLASS LINING

Reactions requiring the use of dry chlorine gas may be performed in glass-lined steel equipment. Capacity range of this equipment is good—from 350 to 2,000 gal. Working jacket and internal pressures vary with particular type of glass-lined steel unit, 150 psi. being about the maximum internal pressure for standard units. The temperature range may be considered to be from 300 to 350 deg. Agitation can be provided in all units by means of glass coated steel agitators and baffles.

Reactions involving wet chlorine gas or chlorine water may also be successfully conducted in glass-lined steel units. Standard capacities and pressures range up to 300 gal., 75 psi. in the jacket, and 38 psi. in the tank proper.

—O. I. Chormann

IRON & STEEL

Carbon steel pipe, fittings and storage tanks are recommended for dry gas or dry liquid. Cast iron satisfactory from corrosion standpoint but steel pipe and forged steel fittings usually used.

Wet chlorine is quite corrosive to iron and steel and usually requires more resistant materials.

—Albert W. Spitz

LEAD

Recommended for moist chlorine up to 230 deg. F. with slight corrosion. Dry gas or liquid: little effect.

Lead pipe used to introduce chlorine into caustic solution in concrete tank to make sodium hypochlorite.

No apparent attack after nine years on lead lined settler tanks; solution is at about 125 deg. F., is saturated with sulphur dioxide and contains 1.9 g. per liter of chlorine.

—H. M. Church

NICKEL & ALLOYS

Among most resistant materials for dry chlorine at high temperatures. Useful upper temperature limits are approximately: 1,000 deg. F. for nickel and Inconel, 850 for Monel; 400-450 for Ni-Resist. Monel widely used for chlorine valve trim, orifice plates, dispensing equipment. Monel and nickel commonly used for reactors, agitators, heating coils, valves, piping and other parts in connection with chlorinations of organic materials where reactants are essentially water free.

Wet chlorine gas below dew point attacks all these materials, as does continuous exposure to chlorine water except in very dilute chlorine concentrations. Tested in acid chlorine water, Monel had a corrosion rate of 43 mils per yr. with 0.02 g. per l. free chlorine and only 1.4 mils per yr. with 0.011 g. per l.

In alkaline hypochlorite bleach solutions, Monel, nickel and Inconel are frequently resistant to concentrations under 3 g. per l. in discontinuous operations. They resist continuous exposure to the very dilute solutions used for sterilizing. Monel used for wire covers and for lining vats and repulper sections of washers used on hypochlorite bleached pulp. Inhibitors such as sodium silicate and trisodium phosphate have marked effect in reducing hypochlorite corrosion of nickel alloys.

—W. Z. Friend

RUBBER LINING

Tanks, pipe and fittings lined with natural and synthetic rubbers are widely used to handle wet and dry chlorine gas, chlorine water and hypochlorite bleach solutions. Chlorine pulp bleaching systems are an outstanding application.

Dry gas has little effect. Wet gas and chlorine water react with surface to form skin of rubber hydrochloride. On soft rubber, skin is brittle and strongly adhered to unreacted rubber underneath. Semi-hard and hard rubbers react more slowly and to a lesser depth, but chlorinated surface powders off more readily. Therefore soft rubber preferred under abrasive conditions despite greater tendency to chlorinate. However majority of chlorine services are non-abrasive and hard or semi-hard compounds are best; first reaction is rapid but film is protective and stops attack.

Handling of hypochlorite bleach solutions is rapidly expanding field for rubber linings. Special pure-gum natural rubber lining is available which will not cause bleach decomposition or permit solution to diffuse through lining and cause blistering; used to handle solutions up to 15 percent available chlorine, and certain sodium hypochlorite solutions that must be kept iron-free.

—O. S. True

SILICONES

Sixteen silicone materials—fluids, resins and elastomers—were tested at 77 deg. F. for resistance to dry chlorine gas, wet chlorine gas, and saturated chlorine water. With a very few exceptions, they rated "good" under ASTM test D-543-43.

Silicone lubricant (Dow Corning Valve Seal A) is used effectively in valves handling low pressure chlorine gas at atmospheric pressure; reports conflict on effectiveness with high-temperature and high-pressure.

Silicone rubber shows very good resistance under above test conditions, rather better to wet chlorine gas than to dry. In one industrial application, silicone rubber gaskets (Silastic 180) are used between glass pipe and ceramic elbow in line carrying steam at 220 deg. F. and a 90-95 percent concentration of wet chlorine gas; still flexible and tight after six weeks where black rubber gaskets hardened and leaked after two or three days.

—J. A. McHard

STAINLESS STEEL

At low temperatures, dry chlorine gas and dry air-chlorine mixtures are withstood by Types 304, 316 and 317. Moisture will cause severe attack, as will temperatures around 800-900 deg. F. Stainless tubing has been used.

Used in some pulp and textile bleaching operations. For example: Type 304, if rinsed with water immediately after use, shows good resistance to calcium hypochlorite up to 3 percent available chlorine for exposures not exceeding 4 hr. Types 316 and 317, which are best grades for bleach applications, have handled alkaline sodium hypochlorite solutions containing 0.3 percent available chlorine for entire bleaching cycles. Type 317 screens widely used for rinsing chlorine bleached pulp and textiles where chlorine is low.

—Grant L. Snair, Jr.

STONEWARE

Very commonly used for hot, moist chlorine gas. Can be and frequently is used for entire chlorine recovery system in electrolytic caustic-chlorine plants. This includes collector piping from cells, fittings, valves, dampers, coolers (chlorine goes from 180 deg. F. down to 60 deg. F.), and the towers where chlorine is dried with sulphuric acid—after which it can be handled in steel.

Also used for various absorption and reaction towers, duct, pipe, fittings, pumps, exhausters and reactors (limited by size and pressure) for handling wet chlorine and chlorine water.

—F. E. Herstein

TANTALUM

Inert to chlorine gas, wet or dry, up to 300 deg. F., and to chlorine water. Used in diaphragms and needle valves for proportioning chlorine to municipal water supplies. Heat exchangers used since 1935 for reacting chlorine

with ammonia to make chemically pure ammonium chloride. Heaters and condensers in numerous other applications involving chlorine, chlorides, and even boiling hydrochloric acid.
—Leonard R. Scribner

WORTHITE

Definitely not suitable for wet chlorine gas. Would not be attacked by dry gas at normal temperature but has no advantage over steel. Worthite pumps widely used in paper and textile industries on hypochlorite bleach solutions. Recommendations for Worthite: Sodium hypochlorite, cold, 3 percent max. available chlorine. Calcium hypochlorite, cold, 3½ percent max. available chlorine. Not recommended for manufacture of these hypochlorites in concentrated form involving 15 to 23 percent available chlorine.

Not visibly attacked by weak chlorine water at ambient temperatures. Oil field salt water which has been chlorinated prior to reinjection into oil sand is handled in Worthite pumps without corrosion. —W. E. Pratt

FATTY ACIDS

ALUMINUM

One of its most important applications is in handling fatty acids. Used extensively for tanks, pipe, condensers, shipping containers, and tank cars; many of these in service up to 18 yr. handling either fatty acids, its derivatives or fats and oils. At storage temperature no attack observed from any uncontaminated fatty acid; heavy-metal or chloride contamination may stimulate attack under some conditions. At boiling temperatures, uncontaminated fatty acids do not attack aluminum, provided at least a trace of water is present at metal surface.

The alloys normally recommended for service with fats and fatty acids are: 2S, 3S and 52S for vessels; 3S and 63S for piping; 3S and Alclad 3S for heat exchanger tubes; 3S, 52S and 61S for shipping containers; and for castings, 43, B214 and 356.

Typical applications in fatty acid production: storage tanks for crude oils and fats, hydrolyzer surge tank, fatty acid vapor condensers (some in service 18 yr. handling stearic, oleic and myristic vapors near 450 deg. F. in presence of steam), piping throughout fatty acid and glycerin systems, distilled fatty acid storage tanks and solidification pans, glycerin condensers, crude and refined glycerin storage tanks. For highly refined fatty acids and glycerin, aluminum tank cars are used to avoid contamination.
—Ellis D. Verink, Jr.

Materials at Work:



CARBON vs. HYDROFLUORIC ACID
Karbate heaters in hydrofluoric-nitric pickling tank.

CARBON

Carbon, graphite and Karbate impervious carbon and graphite are completely resistant to fatty acids. Used particularly where other corrosives are also present or where freedom from metallic pick-up is required.

In reducing atmospheres structural carbon and graphite are unattacked at any commercial temperature, while the working range in oxidizing atmospheres is limited only by the threshold oxidation temperatures.

Karbate can be used up to 340 deg. F. and is especially useful for heat exchangers.

As examples of large units employing Karbate tube construction, evaporators are used for the concentration of lactic acid to 50 percent strength under vacuum on the tube side and steam of 6 psig. within the steel shell. The tubes of one unit in service for four years show no evidence of chemical attack. Condensation of lactic acid is carried out in Karbate tube condensers with water at 45 psig. on the shell side. After several years operation in a similar process, Karbate impervious graphite tubes installed in a levulinic acid evaporator are unattacked; liquid transfer is accomplished with a Karbate centrifugal pump operating at 1,800 rpm.

Structural carbon and graphite are useful as troughs, ducts and linings for tanks, towers, digesters and reaction vessels where slight porosity is permissible. —W. W. Palmquist

CHLORIMETS

Very resistant. Chlorimet 3 practically unaffected at temperatures approaching 600 deg. F. However, it is not often necessary to resort to Chlorimets 2 or 3 except where stainless steels, aluminum, Monel or other commonly used alloys are not satisfactory. For example, wet end parts of Duriron pump handling sulphuric-acidified fatty acids at 150-180 deg. F. were converted to Chlorimet 3. Duriron was excellent from corrosion standpoint, but operator desired better mechanical properties to withstand steam cleaning. Tests on other alloys mentioned above indicated Duriron or Chlorimet type alloys should be used to insure product purity.
—Walter A. Luce

COATINGS

All things considered, baked phenolics are probably best bet.

Solvent action of fatty acids eliminates polystyrenes, polyethylenes, natural rubber and GR-S. Butyl, neoprene and buna-N would only be slightly tendered. Solvent action could also leach plasticizer and cause eventual failure of otherwise resistant materials (such as polyvinyl acetate or chloride or their copolymers, or vinylidene chloride) unless they are compounded with non-soluble plasticizers. Air dryed or baked vinyls or vinylidene chloride are satisfactory but must be examined occasionally to catch incipient failure by plasticizer extraction.

Advantages of baked phenolics: Completely resistant to solvent action, contains no plasticizers, readily and inexpensively applied, withstands continuous service to 375 deg. F., adherent, hard, easy to clean. Its thickness limitation, 10 mils, is no disadvantage in fatty acid service because occasional discontinuities in film will do no harm—corrosion of underlying steel will not be accelerated and product contamination will be insignificant. —Kenneth Tator

DURIMET 20

Wide application handling fatty acids alone or with sulphuric acid. Economical province, compared to standard stainless, is where metal contamination is the issue, or under

erosion-corrosion conditions found in pumps and valves. Tests indicate Durimet 20 can be applied to fatty acids up to temperature slightly over 500 deg. F.

Some typical service applications: Valves for stearic, oleic and palmitic acids, selected in preference to 18-8SMo (Type 316) because of product purity and erosion-corrosion. Durimet replacement parts being ordered by a soap manufacturer for his 18-8SMo pumps handling various fatty acids at various temperatures; replacements are giving better life than original parts. Durimet steam jet used to heat batch tank where stearic acid is reacted to form zinc and aluminum stearates. Numerous other varied services, including the caustic, sulphuric acid and glycerin associated with fatty acid processing.

—Walter A. Luce

DURIRON

Excellent corrosion resistance to the various fatty acids even at temperatures approaching 600 deg. F.; also highly resistant if sulphuric acid is present as in sulphonation and esterification. However, susceptibility to thermal and mechanical shock limits usefulness, especially since conventional stainless, high-alloy stainless, aluminum and others are also highly resistant.

Used occasionally however; Duriron pump handles stearic acid during manufacture of zinc and aluminum stearates. Some Duriron valves are in various fatty acid services.

—Walter A. Luce

GLASS LINING

Entirely resistant to all fatty acids at temperatures normally encountered. Used where absolute freedom from metallic contamination is required. For example:

Greatest application is in manufacture of quality cosmetics where steam jacketed open kettles are used to melt solid fatty acids prior to emulsification, saponification or treatment with mineral acids.

Large tanks for the storage of oleic acid have been used for a number of years with success. In this application again it is necessary to avoid metallic contamination during the period of storage.

IRON & STEEL

Not generally used in fatty acid service. Where product contamination is not objectionable, some fatty acids may be handled in steel provided temperature does not exceed about 85 deg. F. Steel drums with a protective lining are widely used for shipping commercial fatty acids.

—Albert W. Spitz

LEAD

Lead-lined wooden tanks commonly used for treating fatty acids. Normal life is two to ten years. Presence of the higher concentrations of sulphuric results in longer life for such lead treating equipment.

Twitchell process is conducted in lead-lined tanks and resulting fatty acids are stored in lead. Lead-lined Twitchell tanks are exposed to boiling mixture of fats and oils, sulphuric acid, Twitchell reagent and fatty acids.

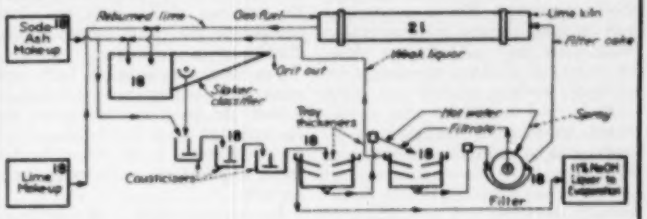
One detergent plant uses lead-lined vessels for fatty acid mixtures at 100 deg. C., and a tellurium-lead steam coil to heat oleic acid to 100 deg. C.

—Kempton H. Roll

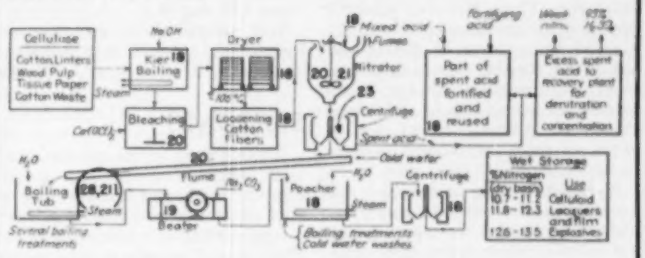
NICKEL & ALLOYS

Nickel, Monel, Inconel and Ni-Resist are all resistant and extensively

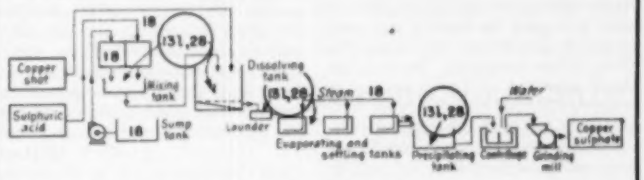
Caustic Soda



Cellulose Nitrate



Copper Sulphate



Key: Materials of Construction

1. Aluminum	11. Impervious Graphite	21. Type 316
2. Brick	12. Iron	22. Type 317
3. Bronze	13. Lead	23. Type 347
4. Carbon Steel	14. Monel	24. Type 430
5. Cast Iron	15. Nickel	25. Stoneware
6. Chemical Lead	16. Rubber	26. Tile
7. Concrete	17. Silica	27. Tygon
8. Copper	18. Steel	28. Wood
9. Glass	19. Stainless Steel	
10. High Silicon Iron	20. Type 304	

o = alloys; l = linings (with steel backing in almost all cases); r = refractory lined; O materials used in combination; two numbers: either material may be used.

used, especially at high temperatures and in presence of sulphuric acid.

In Twitchell process, where sulphuric is present, Monel commonly used for solid or lined splitting tanks, steam coils, pipe and fittings. Also for tanks and auxiliary equipment in sulphuric washing of fats and fatty acids. Inconel sometimes used in sulphuric washing of highest quality stearic acid to maintain the best possible color.

One of the most interesting developments in fatty acid production is the use of continuous, countercurrent high temperature splitting of fats with hot water. These processes generally operate under pressures of 600 to 725 psi. and temperatures of 490 to 500 deg. F. Inconel has proved to be one of the most corrosion resistant materials for use in this process and several continuous splitting towers are in operation made of Inconel-lined or Inconel-clad steel construction.

Ni-Resist used for still bodies and pumps in some fatty acid batch distillation equipment. In more modern and more common continuous distillation process, in plate and cap towers, Inconel is used for towers, plates, caps, tubular preheaters and piping; Monel sometimes used for bubble caps and piping. Tested in one such tower distilling tallow fatty acids, Inconel and Monel corroded at 4 mils per yr. in vapors (470-510 deg. F.) and 8-10 mils in liquid (500-550 deg. F.).

Inconel also used successfully in continuous distillation of tall oil for stills, heaters and associated equipment. Monel is used in sulphuric acid splitting of tall oil soaps. Inconel-clad steel and nickel-clad steel used for storage of refined fatty acids.

—W. Z. Friend

RUBBER LINING

All fatty acids can be handled by rubber linings, but they are not used much because service is rarely severe enough. If, as sometimes happens, 2-10 percent of fatty acids are present in an otherwise corrosive mixture, the presence of the fatty acid does not prevent the use of rubber to handle the other corrosives.

For lower members of fatty acid series such as propionic, hard natural rubber and butyl are satisfactory for concentrated acids up to about 160 deg. F. Butyl is better where flexibility is required since its compounds are soft.

For higher weight acids like lauric and stearic, buna-N linings are satisfactory for concentrated acids up to about 180 deg. F.

Soft natural rubber and neoprene linings should not be used with fatty acids.

—O. S. True

SILICONES

Silicone fluids, resins and elastomers were tested in stearic acid at 100 deg. C., and except for one type of fluid all showed very good resistance.

Applications of silicone products: Fluid is used to reduce foam in vats of linseed oil and in processing of fats for soap production. Silicone compounds have been used as substitute for grease in cooking. Silicone lubricant used for valves handling stearic acid at temperatures up to 95 deg. C. Tests have shown silicone pigmented enamels have good resistance to butter, corn oil, lard and peanut butter.

—J. A. McHard
J. T. McIntyre

STAINLESS STEEL

Excellent resistance to any of the fatty acids under practically all service conditions encountered in the fields employing fatty acids. Used for storage tanks, shipping containers, reactors, heat exchangers, heating coils, piping, valves, pumps, centrifugals, etc.

Types 304, 347 and 316 are most suitable—Types 304 and 347 for service up to 200 deg. F., Type 316 for higher temperatures and more corrosive conditions. Type 316 safely resists formic acid (the strongest acid in the series) and its solutions and vapors in all concentrations at a temperature of 300 deg. F.

Typical applications: Reactors lined with Type 304 for hydrogenation of oils for soap and edible fats. Type 304 homogenizers to make oil and wax emulsions. Stainless equipment for processing various oils and oil products used in textile industry as lubricants, solvents, and scouring, wetting and emulsifying agents. Type 316 sulphonating tanks, heating coils and piping for sulphonation of vegetable and animal oils (sulphuric acid concentration and temperature determine whether stainless can be used for sulphonating equipment).

—Grant L. Snair, Jr.

STONEWARE

Impervious to all fatty acids at all temperatures and pressures at which stoneware is commonly used. Application is limited in that most fatty acid vessels usually call for higher operating pressures than are normally used with stoneware. Size is also a factor; fatty acid equipment is comparatively large and normally over the 800-gal. limit generally set for one-piece stoneware vessels.

Has been used, however, for piping (up to 100 psi.), valves, fittings, pumps, exhausters, and occasionally for the smaller storage vessels and for small batch reaction kettles up to 350 gal.

—F. E. Herstein

TANTALUM

No attack by any of the fatty acids has ever been reported. However, less expensive materials are usually sufficiently resistant so that tantalum is not considered necessary. Tantalum heating coil was once applied in a process where pure white stearic acid, free from iron, was needed in the production of a cosmetic.

—Leonard R. Scribner

WORTHITE

Hundreds of pumps and over a thousand valves used for handling pure and crude fatty acids and mixtures, many containing such contaminants as sulphuric acid, Twitchell reagents, glycerine, salt, spent lye and various catalysts. Worthite recommended over standard stainless types (which are satisfactory for general use) when velocity is high, as in centrifugal pumps, and especially if sulphuric acid is present. Plant test in commercial fatty acid still with violent circulation showed Worthite with corrosion rate of 0.6 mils per yr., where rates for Types 316, 317, and 347 were 4.1, 3.8 and 10.0 mils per yr., respectively. Over 200 Worthite pumps purchased in 1948 for continuous fat splitting and soap processes. Also used widely in such processes involving fatty acids as tall oil refining, sulphonated oils and esters, solvent extraction, hydrogenation, catalyst recovery, dehydration. Many plants use Worthite pumps and valves for transferring and filtering operations in the glycerine recovery process.

—W. E. Pratt

Materials at Work:



MONEL vs. FATTY ACIDS
This Monel vessel has given long service in processing fatty acids.

HYDROCHLORIC ACID

ALUMINUM

Not recommended. Aluminum alloys are vigorously attacked by all but the most dilute concentrations of hydrochloric acid —Ellis D. Verink

CARBON

To HCl solutions, carbon, graphite and Karbate impervious carbon and graphite are inert at all concentrations and all temperatures. For HCl gases, wet or dry, they may be used up to 660, 750 and 340 deg. F., respectively, in presence of oxygen—and up to 1,110, 1,200 and 340 deg. F. in absence of oxygen. (If walls are held to these temperatures by cooling, gas stream may be much hotter.)

Very widely used for metal pickling, cleaning, etching; byproduct HCl recovery from organic chlorinations; HCl hydrolysis of cereal foods, vitamin slurries, paint pigment slurries; virtually all HCl solutions except highly oxidizing, like aqua regia or the 96+ percent sulphuric used in HCl drying towers. More Karbate tubes and towers used for HCl absorption than all other construction materials put together.

From multitude of applications one that illustrates versatility of these materials is production of HCl gases from caustic-chlorine cell gas. Hot wet cell gas is introduced through Karbate nozzle into water-cooled graphite combustion chamber where flame temperatures range from 1,000 to 3,000 deg. F. Gases at 350-500 deg. F. go from chamber directly to Karbate falling-film hydrochloric acid absorber. Karbate steam jet ejector maintains slight vacuum in combustion chamber and absorber. Karbate pumps, pipe and valves convey 32-36 percent acid from absorber to Karbate stripping tower where constant-boiling acid bottoms at 260-270 deg. F. are heated by Karbate shell-and-tube boiler. Stripper overhead is dried by water and brine cooled Karbate condensers to give 99.5 percent HCl gas at 10 deg. F. with 0.01 percent water vapor. The 260-270 deg. F. stripper bottoms go by Karbate pump through Karbate cascade or concentric tube cooler back to absorber where it is the absorbing liquor. —W. M. Gaylord

CHLORIMETS

Chlorimet 2: Good results in all concentrations even at boiling temperatures. In laboratory tests in boiling acid it showed corrosion rates less than 10 mils per yr. in concentrations under 10 percent, and less than 20 mils per yr. in concentrations between 10 and 30 percent. At lower temperatures the rates would be much lower. Rapidly attacked if ferric chloride is present.

Chlorimet 3: Definitely not for boiling acid of any appreciable concentration (600 mils per yr. in 5 percent boiling). Laboratory tests in 10 to 37 percent acid showed rates between 30 and 60 mils per yr. at 122 deg. F.; between 50 and 70 mils per yr. at 158 deg. F. Chlorimet 2 generally preferred over Chlorimet 3 unless oxidizing conditions exist. Some laboratory indication that Chlorimet 3 can stand presence of some ferric chloride at room temperature—but test first.

Some successful applications: Several Chlorimet 2 pumps handling various concentrations of very hot acid in production of anhydrous HCl; Chlorimet 2 pumps and valves handling various concentrations and temperatures in plant producing dyes and detergents; Chlorimet 3 highly resistant to scrubber solution consisting of mixture of hydrochloric, sulphuric, nitric, selenous acids and sodium chloride at 140-150 deg. F.; Chlorimet 2 pumps in hydrochloric acid recovery system handling concentrations up to 35 percent at 120 deg. F.

—Walter A. Luce

COATINGS

Most common organic coating materials are resistant. Exceptions are polysulphide rubbers and cellulose esters and ethers. Films must be thick, tough and resilient so that slightly imperfect application or slight injury in use do not expose base metal. This eliminates baked phenolics and all other air-dried or bake sprayed-on coatings even though materials themselves may be inert. Remaining are the rubbers, rubber-like vinyls, polyethylene, polystyrene and vinylidene chloride.

All of the rubbers are suitable if properly compounded by the manufacturers for hydrochloric acid service. Natural rubber, GR-S, neoprene, and butyl rubber are in extensive satisfactory use. Natural rubber on initial contact with hydrochloric acid forms a surface film of rubber hydrochloride which resists further absorption. The other rubbers do not form this secondary barrier but have sufficient resistance in themselves to be satisfactory linings. The rubbers should not be used without previous verification at temperatures above 180 deg. F. Neoprene may be safely used at temperatures up to 220 deg. F.

Rubber-like vinyls, as sheet or deposited from plastisols, are satisfactory if proper-compounded for HCl service. Should not be used over 180 deg. F. without prior trial.

Polyethylene, polystyrene and vinylidene chloride in sheet form are extensively used; should not be used over 170 deg. F. without completing a prior trial. —Kenneth Tator

DURIMET 20

Shows satisfactory resistance to many hydrochloric acid solutions provided temperature doesn't go above atmospheric. Tests indicate it is satisfactory up to 25 percent concentration. For example: showed very low corrosion rate when tested in solution of 3 percent acetic acid plus slight amount of hydrochloric at room temperature. Pumps performing well in spent acid solution at normal temperatures containing small amounts of hydrochloric, nitric, sulphuric and hydrofluoric acids. However, the Duriron Co. generally recommends Chlorimet or Durichlor alloys rather than Durimet 20 for HCl services. —Walter A. Luce

DURIRON & DURICHLOR

Durichlor has long been used for all concentrations at temperatures close to boiling. One of the few commercial alloys for strong acid above 150 deg. F. Durichlor usually recommended over Duriron for hydrochloric acid, although latter is often satisfactory at temperatures approaching 150 deg. F. for concentrations below 10 percent, and at room temperature for concentrations above 10 percent.

Some examples of Durichlor's resistance and application: Pumps handling 180 deg. F. metallurgical sludge containing 5-10 percent HCl. Plant tests in commercial hydrochloric acid at 120-130 deg. F. indicate life expectancy of over 15 yr. for pumps, valves, pipe and fans. Very large number of pumps used by chemical industry for hydrochloric at normal temperatures; some in service over 12 yr. Plant tests found all alloys recommended for hydrochloric acid service except Durichlor were unsuitable for handling hydrochloric acid saturated with chlorine and containing decolorizing carbon along with some manganese dioxide.

Presence of appreciable ferric chloride, as in a recirculating system, may reduce life of Durichlor equipment considerably. —Walter A. Luce

GLASS LINING

Fully resistant to hydrochloric acid at all concentrations and temperatures. Jacketed reactors with glass covered agitators and baffles widely used in many industries under great variety of conditions. Undoubtedly, hydrochloric acid "sells" more glass covered reactors, agitators, stills, condensers, receivers, crystallizers, pumps, valves, pipe and storage tanks than any other corrosive in the chemical industry.

Some typical services: Reactors of 3,500 gal. capacity operating at 125 psi. internal pressure in production of vinyl plastics. Reactors for hydrolysis of proteins with strong hydrochloric acid at high temperatures and pressures. An unusually severe service in petroleum industry for production of hydrochloric acid from salt and sulphuric acid. Manufacture of many pharmaceuticals where hydrochloric is involved and product purity is paramount. —S. W. McCann

IRON & STEEL

Can be used for dry hydrogen chloride gas or hydrochloric acid vapors if they are at temperatures above the dew point. All aqueous solutions, including moist gas, corrode iron and steel rapidly and their use is not advisable. —Albert W. Spitz

LEAD

Not generally recommended, but has been used with some corrosion in concentrations up to 30 percent at room temperature and up to 20 percent at 212 deg. F. Strong, concentrated acid can be used cautiously with either chemical or antimonial lead at room temperature. Anhydrous HCl is occasionally handled in lead. By-product HCl gas from some chlorination processes is handled in lead equipment.

Attack is accelerated by agitation, which removes the slightly soluble corrosion product, lead chloride. Impurities in the acid may also act as accelerators—for example, 0.5-0.8 percent chlorine may double corrosion by commercial acid, and 1 percent ferric chloride may multiply it five times.

—Kempton H. Roll

NICKEL & ALLOYS

Nickel and Monel usefully resistant to dilute HCl solutions even at elevated temperatures. Used frequently in handling of solutions or mixtures which contain small amounts of hydrochloric acid, such as distillation and condensation of chlorinated solvents and other chlorinated organics containing moisture, and of numerous acid (but non-oxidizing) chloride salts, where low concentrations of hydrochloric acid are formed during evaporating or condensing. Nickel and Monel stills and condensers used in solvent extraction of oils, metal degreasing, dry cleaning, production of chlorinated solvents and other organics. Monel pickling tanks regularly used for 10-15 percent acid at room temperature. At room temperature Nickel and Monel are limited to 20 percent acid in unaerated solutions, 5 percent in aerated. In unaerated 5 percent acid nickel is usefully resistant up to about 165 deg. F., Monel up to about 130 deg. F.

Inconel has fair resistance to dilute acid at room temperature, but is not generally as good as nickel or Monel; has shown good resistance to cold, aerated acid under 2 percent. The Ni-Resist alloys can frequently be used with very dilute solutions at room temperature, and under these conditions are much superior to plain cast iron.

None of these materials is subject to stress corrosion cracking in hydrochloric acid or acid chloride salts. None can be used with oxidizing acid chloride salts like ferric, cupric or mercuric except in extremely dilute solution. Nickel, Inconel and Monel are used with hydrogen chloride gas and have useful resistance up to 1,000, 1,000 and 800 deg. F. respectively.

—W. Z. Friend

RUBBER LINING

Soft natural rubber used extensively to line storage tanks for concentrated acid up to 140 deg. F. Semi-hard natural rubber used to line pipe, fittings, reaction vessels and other equipment for concentrated acid up to 160 deg. F. Special flexible ebonite linings used for concentrated acid up to 180 deg. F. and 20 percent acid up to 220 deg. F.

Resistance of soft natural rubber depends on surface film of rubber hydrochoride. Lining will fail if film is removed by abrasion, excessive washing especially with hot water, or by contact with neutralizing chemicals like caustic soda. Film is formed by concentrated (20 Be.) acid but not by dilute. Therefore soft natural rubber is risky for dilute acid. The answer for dilute acid is material that doesn't depend on protective film—semi-hard or flexible ebonite if equipment is safe from mechanical or thermal shock, specially compounded butyl if flexibility is required as in transportation tank. —J. P. McNamee

SILICONES

Exceptionally resistant to aqueous HCl at ordinary temperatures and in many instances at 100 deg. C. Four fluids, four resins and two rubbers were exposed to 10 percent, 20 percent and concentrated acid at room temperature, and to 10 and 20 percent acid at 100 deg. C., with the following results.

Fluids and Greases—Uniformly high resistance at all test conditions except for slight tendency of some fluids to gel or emulsify at 100 deg. C. Dow Corning Valve Seal A used to lubricate valves handling dry HCl at high and low temperatures, to lubricate plug cocks handling HCl gas at 410 deg. F., and to prevent seizure of fittings and bolts on hydrochloric acid equipment.

Resins—All resins showed good resistance at all test conditions, except

Materials at Work:



STAINLESS vs. FATTY ACIDS

Stainless run-off and blending tanks and stainless pipes in a fatty acid plant.

that one rated only fair in 20 percent acid at 100 deg. C. Heat resistant silicone-base finishes are widely used for stacks handling corrosive gases; some have outlived conventional organic finishes by several years.

Rubbers—Both rubbers in test (Silastics 180 and 181) showed good resistance to all concentrations at room temperature. At 100 deg. F. both rated fair in 10 percent acid, poor in 20 percent acid. —J. A. McHard

Leon Van Volkinburg

STAINLESS STEEL

Not ordinarily recommended for any hydrochloric acid solution even at room temperature. Addition of molybdenum, as in Type 316, does lower solubility rate somewhat, but not enough to permit its use.

Solutions of certain chlorides, such as magnesium or calcium chloride, in which minute amounts of hydrochloric acid may be formed by hydrolysis are better handled by Type 316; pitting can occur much more readily with Type 304.

Unlike the case of sulphuric acid, the addition of salts or other compounds to hydrochloric acid does not inhibit attack to any useful extent.

—W. G. Renshaw

STONEWARE

Completely impervious to hydrochloric acid solutions of all strengths and at all temperatures. Widely used.

Stoneware towers and tourills are classic for absorption of HCl in manufacture of the acid. Low heat transfer overcome to some extent by development of stoneware bodies with high silicon carbide content. Common practice today is use of impregnated graphite, tantalum or thin-walled glass tubing for heat transfer surfaces and stoneware for main body of the absorber and for circulating system.

Typical applications in both manufacturing and consuming plants: Batteries of stoneware vessels for storage; pumps, valves, pipe and fittings; kettles and reaction vessels up to 350 gal. capacity; towers for fume absorption or reaction. —F. E. Herstein

TANTALUM

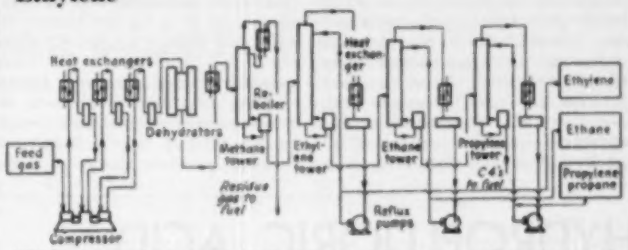
Inert. Used considerably for heat exchangers.

Completely immune to all concentrations and temperatures ever encountered in tests or in use. No organic or inorganic mixture containing hydrochloric acid, including aqua regia, is known to attack tantalum at temperatures below 350 deg. F., except those containing hydrofluoric acid or free SO_3.

Heat transfer property is asset; coefficients above 3,000 Btu./sq. ft./hr./deg. F. are common between steam and hydrochloric acid. Hundreds of tantalum heat exchangers are in service, including coils, bayonet heaters, condensers and absorption plants. There has never been a reported case of failure due to corrosion.

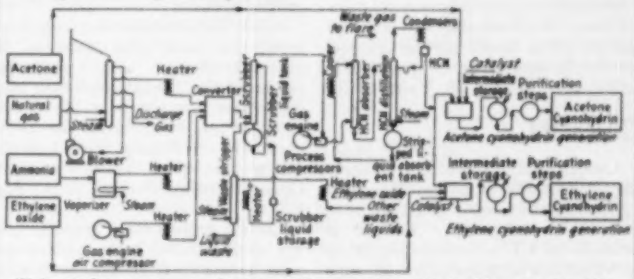
—Leonard R. Scribner

Ethylene



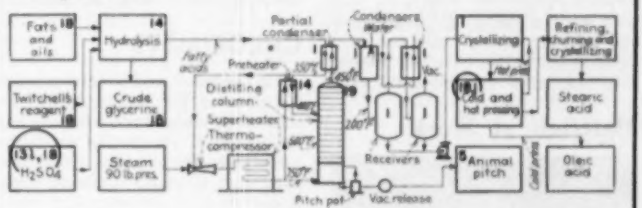
Mild steel throughout except 3½% nickel steel for top of methane tower and related equipment.

Ethylene Cyanohydrin



Plain steel except towers & piping: 21; to avoid contamination: 20; for high temp.: 19 (309 & 310); pumps & valves: Worthite & Durimet 20.

Fatty Acids



Key: Materials of Construction

1. Aluminum	11. Impervious Graphite	21. Type 316
2. Brick	12. Iron	22. Type 317
3. Bronze	13. Lead	23. Type 347
4. Carbon Steel	14. Monel	24. Type 430
5. Cast Iron	15. Nickel	25. Stoneware
6. Chemical Lead	16. Rubber	26. Tile
7. Concrete	17. Silica	27. Tygon
8. Copper	18. Steel	28. Wood
9. Glass	19. Stainless Steel	
10. High Silicon Iron	20. Type 304	

n = alloys; l = linings (with steel backing in almost all cases); r = refractory lined; O materials used in combination; two numbers: either material may be used.

WORTHITE

Not considered a good material for handling hydrochloric acid, but over 100 pumps are in service on cold, weak

solutions, notably for inhibited HCl in chemical descaling work. The usual inhibitors do not protect Worthite but they do prevent pick-up of copper and iron chlorides, which are corrosion accelerators, from equipment being pickled or cleaned. Usual descaling operation uses cold 10 percent acid. Laboratory test approximating this condition—i.e., 10 percent acid at 80 deg. F. with normal amount of air in solution and agitated at 5 ft. per sec.—gave corrosion rate of 120 mils per yr. (Previously published rate of about 40 mils per yr. is too low because test was made without agitation.) However, the 120-mil rate is not strictly applicable to descaling work because of many conditions that favor the pump, namely: original acid strength quickly reduced by dissolving scale; flushing cleaned equipment with alkaline solution passivates Worthite for next job; pump is usually exposed only 45 min. to 3 hr. at a time. Where these conditions are optimum and actual service totals about 100 hr. per yr., Worthite pumps have lasted 10 yr. Where flushed only with water and in service 1,500 to 2,000 hr. per yr. some replacement parts at least are needed after 9-10 months.

—W. E. Pratt

HYDROFLUORIC ACID

ALUMINUM

Hydrofluoric acid solutions are good etchants for aluminum. Hence aluminum alloys would not be selected for use in equipment to handle this acid. —Ellis D. Verink, Jr.

CARBON

Carbon and graphite are resistant to all strengths of hydrofluoric acid (including anhydrous) at all temperatures used industrially. Karbate is resistant to HF in concentrations up to 48 percent at temperatures through the boiling point and up to 60 percent at 185 deg. F.

Karbate is used in weak acid absorption equipment. Towers are lined with carbon brick; distributor trays and packing support grills are fabricated from carbon. Carbon Raschig rings are used as packing. Karbate cascade coolers and centrifugal pumps give excellent service in recirculating cooling systems.

Many Karbate immersion type heat exchangers have been installed in nitric-hydrofluoric acid, alloy-steel pickling tanks. Karbate plate type heat exchangers give a service life far in excess of any other heater previously used. HF in these pickling tanks is 2-5 percent, nitric is 15-20 percent. Operating temperatures: 150-212 deg. F.

Carbon spray towers, graphite baffles and Karbate spray nozzles are used in scrubbing systems to remove fluorine from stack gases in fertilizer and phosphoric acid plants. Karbate centrifugal pumps are also used in these systems. —J. F. Revilock

Materials at Work:



DURIRON vs. SODIUM CHLORIDE
High-silicon iron pump used to handle 5 percent brine.

CHLORIMETS

Chlorimets 2 and 3 have excellent resistance to HF and its solutions at all concentrations up to relatively high temperatures. In general, use Chlorimet 2 under reducing conditions, Chlorimet 3 under oxidizing conditions.

Chlorimets are relatively high-cost materials; service conditions should be severe—additional corrosives, high temperatures, aeration—before they are used in preference to other HF-resistant alloys. Chlorimet 3 pumps can handle 6 percent aerated HF at 90 deg. F. where complete freedom from metallic pick-up is essential. Other uses: manufacture of HF where fluorspar is treated with concentrated H_2SO_4 at high temperatures; handling mixture of HF, H_2SO_4, water and a fine abrasive in suspension at about 35 deg. C. —Walter A. Luce

COATINGS

Thin sprayed and baked phenolics or furans protect mild carbon steel from attack by HF stronger than 60 percent; coatings are not necessary with acid below 60 percent.

Most organics are charred or dehydrated by anhydrous HF; this is resisted best by the hydrocarbons, such as polyethylene. Teflon is most resistant and is in wide use for gaskets.

Thin coating films are not recommended as imperfections will expose underlying metal to attack. Lining thickness should be at least ¼ in. for production equipment. If the lining does not have adequate resilience, use a carbon brick overlining.

For concentrations below 98 percent and temperatures below 350 deg. F., filled phenolics or furans are satisfactory. Carbon-filled material is suitable; do not use asbestos, silica or glass fiber fillers.

Hard or semi-hard natural rubber is used at acid concentrations up to 40 percent and temperatures up to 150 deg. F. Do not use soft natural rubbers with acid below 30 percent strength. Neoprene is preferred, is satisfactory with acid up to 60 percent and temperatures up to 150 deg. F. Butyl rubber is suitable below 130 deg. F.

Polyethylene, polystyrene, methacrylates and vinyls have been successfully used below 120 deg. F. and concentrations up to 60 percent. Be certain that the resin plasticizer and stabilizer are also resistant. One HF manufacturer tries to standardize on carbon brick linings (set in carbon-filled phenolic cement) over neoprene membrane. —Kenneth Tator

DURIMET 20

Good resistance to many concentrations, especially under oxidizing conditions. Corrosion rate of Durimet 20 at 80 deg. C., as mils per year: 11 for 5 percent HF, 21 for 15 percent acid, 28 for 25 percent acid. Rate is slower at lower temperatures.

Plant experience shows Durimet 20 to be acceptable for pure acid above 60 percent strength. One plant uses Durimet for 60 percent HF at ambient temperatures and 80 percent acid at about 35 deg. C. It has also been successfully used with AHF. After 2 years of service on cold HF, Durimet 20 "Y" valves showed no signs of corrosion.

This alloy gives exceptional service with aerated HF or HF solutions with oxidizing materials. Example: stainless steel pickling solution containing 3-5 percent HF and up to 20 percent nitric at temperatures up to 170 deg. F. For handling such solutions valves, jets, tank outlets and pumps of Durimet 20 are in use. Durimet valves are used by refineries in HF alkylation processes. Tests show that Durimet can be used in the production of HF where concentrated H_2SO_4 is used under slightly oxidizing conditions, for handling halogen tin plating solutions and crude phosphoric acid production by the wet process.

—Walter A. Luce

DURIRON

High-silicon iron alloys are attacked by HF. They must not be used where this acid or other forms of the free fluoride ion are encountered. There is some indication that high-silicon irons can be used with certain compounds containing fluorine (fluoborate plating solutions) if this element is combined as a stable radical. Be sure to conduct thorough tests first.

—Walter A. Luce

GLASS LINING

Since glass linings are based primarily on silicates, they should not be used with hydrofluoric acid under any conditions. —S. W. McCann

IRON & STEEL

Carbon steel is widely used for hydrofluoric acid in concentrations above 75-80 percent and under 150 deg. F. It is corroded by acid under 70 percent at atmospheric temperature or AHF over 150 deg. F. It should not be used under these conditions. Cast iron should not be used with HF.

Hardened steels in HF may be subject to embrittlement; this does not hold for soft-low-carbon steels. Scale on carbon steel surfaces in AHF service may cause trouble with moving parts. —Albert W. Spitz

LEAD

Lead 3/16 in. or more thick usually gives excellent service with hydrofluoric acid, particularly at room temperature. Limiting concentration is 60-65 percent acid, depending on temperature. Although lead has been used with unaerated 60 percent acid up to the boiling point (184 deg. F.), it should be used with caution with acid above room temperature.

Where lead is used for hydrofluoric storage, conveying and pumping. It was once widely used for shipping the acid. —Kempton H. Roll

NICKEL & ALLOYS

Monel is resistant to all concentrations of the acid (including AHF) over a wide range of temperatures. In HF solutions, except in those highly aerated, it is satisfactory up to 250 deg. F. It is not adversely affected by small amounts of reducing sulphur or of sulphuric acid. Its corrosion rate may be appreciably increased by aerating the HF solution.

Monel is not subject to stress-corrosion cracking in HF which does not contain appreciable amounts of fluosilic acid. It is comparatively insensitive to velocity effects; hence bubble caps in distillation columns can be made of Monel. It is used for such equipment as acid recovery towers and heaters, valves, bolts, pumps and pipelines in refinery alkylation units.

Corrosion rates for Monel also apply to "K", "H" and "S" Monels. "K" is used for pump shafts, valve stems and bolts which are subject to high stresses. "S" is used for gate and plug valves, pump parts and sometimes for non-lubricated bearings.

Nickel should not be used in dilute HF solutions above 170-180 deg. F. In commercial 60-65 percent acid it is severely corroded at atmospheric temperature.

Inconel resists aqueous HF at atmospheric temperature and sometimes to 160-170 deg. F. Small amounts of ferric salts in commercial acid improve its performance.

Ni-Resist resists dilute HF solutions at atmospheric temperature but not elevated temperatures. It is corroded by commercial 60-65 percent acid at room temperature.

Laboratory tests show Monel, nickel and Inconel to be among the materials most resistant to AHF up to 1,100 deg. F. Nickel and Monel show suitable resistances to HF-steam mixtures.

Nickel and Monel are resistant to florine at high temperatures, having useful resistance up to about 1,000 deg. F. At higher temperatures nickel is more resistant. If sulphur compounds are present in fluorine or HF gas, nickel and Monel may be subject to intergranular sulphide attack above 570 deg. F. In such applications Inconel may be more suitable within certain temperature ranges.

—W. Z. Friend

RUBBER LINING

Soft butyl and neoprene linings are suitable for handling 60 percent acid up to 160 deg. F. Weaker concentrations can be handled up to 220 deg. F. Hard natural rubber will handle 40 percent acid at room temperature or weaker acid at slightly higher temperatures. Soft natural rubber linings should not be used with HF solutions containing more than 3 percent acid at room temperature.

Where butyl and neoprene lnings are used satisfactorily: storage vessels, pipe and fittings, reaction vessels and shipping containers.

Butyl linings are superior to neoprene above 200 deg. F. At lower temperatures neoprene linings are better, especially under abrasive conditions.

Mixtures of HF with other acids such as nitric can be handled satisfactorily with neoprene or butyl linings if the concentration of each acid does not exceed 35 percent at room temperature. —E. L. Lockman

SILICONES

Dry HF rapidly attacks silicone fluids and polymers. Aqueous acid reacts more slowly; the extent of reaction depends on the type of silicone. The silicones are broken down into more volatile products.

—J. A. McHard
A. F. Kolb

STAINLESS STEEL

Hydrofluoric acid destroys the protective film essential for the good corrosion resistance of stainless steels. None of the stainless steels are recommended for HF solutions of any concentrations even at low temperatures. There is one exception: AHF at room temperature. Stainless steels cannot be used for handling the bifluoride (acid fluoride) salts.

Type 316 offers best resistance of any of the stainless steels to normal fluoride salt solutions. But is is necessary to know complete service details before an accurate recommendation can be made.

Nitric acid or other strong oxidizing agents in dilute hydrofluoric acid almost completely inhibit attack of the stainless steels. Inhibiting effect becomes less as the HF concentration is increased beyond a few percent. For example: corrosion of Type 310 in a solution of 90 percent nitric and 5 percent HF at 100 deg. F. is about 200 mils per year.

—W. G. Renshaw

STONEWARE

Not suitable for use with HF under any conditions. —F. E. Herstein

TANTALUM

Rapidly attacked by hydrofluoric acid. —Allan L. Percy

WORTHITE

Generally not classed as the material most economically suitable for fluorine or hydrofluoric acid. Resistant to AHF. More resistant than steel, less resistant than Monel, to strong aqueous solutions. At concentrations below 60 percent HF, Worthite is severely corroded.

Worthite pumps are used to handle fluoborate plating solutions, which are not corrosive to this alloy. Crude phosphoric acid up to 75 percent with about 0.5 percent HF can be handled successfully up to 205 deg. F. in Worthite pumps and valves. One pump (with mechanical seal) is being used satisfactorily on hot, crude H_3PO_4 containing approximately 3 percent HF.

A mixture of 90 percent H_2SO_4 and 10 percent HF at room temperature gave a corrosion rate of 10 mils per year. The user considers Worthite satisfactory under these conditions.

—W. E. Pratt

NITRIC ACID

ALUMINUM

Concentrated (82 percent or above) acid and vapors have only slight effect at room temperature. It is used commercially in reaction vessels for catalytic oxidation of NH_3, cooling coils, condensers, for concentration of the acid and pressure piping. Aluminum alloys 2S, 3S, 4S, 52S, 61S are recommended for tanks. For pipes 2S, 3S, 61S, 63S are recommended. For cast parts 43, B214, 356 are normally recommended.

It has been used in manufacture of nitric acid base explosives and processing ammonium nitrate. Aluminum evaporators, crystallizers, prilling towers, hot and cold solution tanks, and pipes have been satisfactory here. It can be used for white and red fuming nitric acids.

Aluminum tankage has handled 88 percent acid up to 50 deg. C. for more than 15 years. Heat exchangers have been satisfactorily employed condensing HNO_3 vapors where the metal temperature was kept below 100 deg. F. Fourteen 61S aluminum alloy tank cars have been built for nitric acid service. They handle 95-99 percent acid with little maintenance. One has been in continuous service for 10 years.

A concentration range of 82-105 percent acid is commercially important for aluminum. —W. W. Binger
Ellis D. Verink, Jr.

CARBON & GRAPHITE

Corrosion resistance of carbon in its different forms varies markedly. Non-graphitic (amorphous) carbon is generally preferred for nitric acid conditions where heat transfer is not a problem. Most widespread use: handling mixtures of nitric acid with other highly corrosive materials which have a non-oxidizing character. Carbon bricks are used in standard construction for lining tanks used to pickle stainless steel in solutions ranging from 10-14 percent HNO_3 and 2-4 percent HF. Such linings have been in service for 14 years with no apparent deterioration of the brick.

Where heat transfer is involved, Karbate impervious graphite is used successfully. Life of several years has been obtained on Karbate equipment operating in solutions 10 percent acid at 185 deg. F. and 40 percent HNO_3 at 140 deg. F. Karbate plate heat exchangers have been in service since 1942 with practically no maintenance.

—W. M. Gaylord

CHLORIMETS

Chlorimet 3's high chromium content makes it applicable for most nitric acid services, but its use is generally limited because of its higher price. Conditions involving severe services with nitric acid as a minor constituent may be handled with this alloy.

Chlorimet 2 is not recommended for nitric acid services.

—Walter A. Luce

COATINGS

The protective coatings and linings industry can not today offer comparable protection to aluminum and stainless steels. If for some reason, properties peculiar to the organics are required, the following experiences will be helpful.

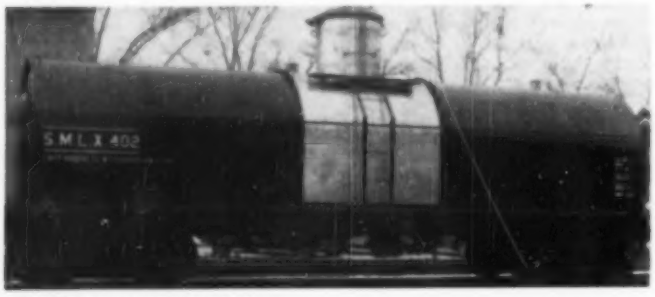
Avoid the use of thin film coatings. Minimum lining thicknesses of ¼ in. are recommended.

The life of any organic barrier will increase with decrease in acid concentration and the service temperature. No currently available organic can be depended upon at acid concentrations above 20 percent or temperatures above 120 deg. F. and it is doubtful whether the most oxidation resistant material will give adequate service life when operated at the top of both of these limits.

Below 5 percent and at room temperatures many of the non-oxidation-resistant organics will demonstrate an appreciable service life although the progress of oxidation may be followed by color change of the material. Included in this group are the phenolics and furans and all rubbers, natural and synthetic except Thiokol.

Select the oxidation resistant organics wherever practical as these may give adequate service life at 10 percent concentration up to 120 deg. F., or at 20 percent concentrations at room temperatures. This group includes polyvinyl chloroacetates and vinylidene

Materials at Work:



ALUMINUM vs. NITRIC ACID
Aluminum alloy tank car used to ship concentrated nitric acid (95-97 percent.)

chlorides, polyethylene and its halogenated derivatives, and butyl rubber. —KENNETH TATOR

DURIMET 20

Durimet 20 gives excellent resistance to nitric acid at all concentrations and temperatures. Numerous service applications can be cited:

1. A chemical plant found Durimet to be much more satisfactory than 18-8 stainless for handling hot, 97 percent nitric acid from concentrating towers.

2. Durimet pumps are used for handling 20-30 percent nitric acid in the manufacture of arsenic acid.

3. Numerous Durimet pumps are used for handling nitric acid and ammonium nitrate solutions. Excellent results reported after five years' use.

4. Durimet is giving excellent results handling hot, dilute nitric acid plus silver nitrate solutions.

5. Durimet steam jets are used in a steel mill in the electrolytic pickling of stainless steel strip. The corrosive solution used is 20 percent nitric acid plus 3-5 percent hydrofluoric acid. This solution proved corrosive to all the metallic and non-metallic materials tested with Durimet 20 giving the best service. —WALTER A. LUCE

DURIRON

Nitric acid and many solutions containing nitric acid have been successfully handled by the high-silicon irons for years. Its susceptibility to thermal and mechanical shock has somewhat limited its use, but abnormally high temperatures are constantly being handled when proper care is exercised. This alloy is also relatively inexpensive compared to other corrosion resistant materials employed for acid services.

It is unattacked by all concentrations of nitric acid at normal temperatures. Increasing the temperature has very little effect on its corrosion resistance. Boiling nitric acid at concentrations above 50 percent has no effect, although weak solutions do show a very slight attack.

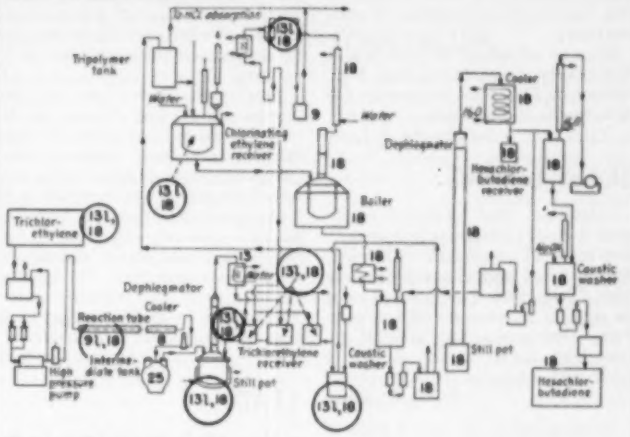
A few examples showing various nitric acid applications to which Duriron equipment has given excellent service:

1. Production of nitric acid by the sodium nitrate-sulphuric acid method. They use complete Duriron installations including denitrators, towers, condensers, pipe, and valves.

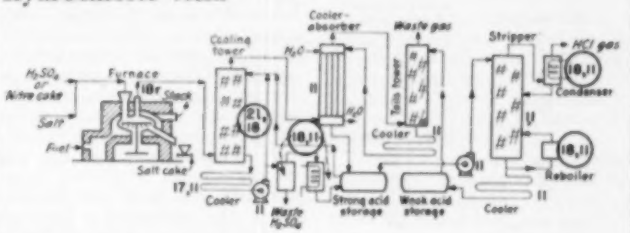
2. In plants making nitric acid by the ammonia-oxidation process Duriron equipment is used extensively in the form of pipe, condensers, pumps, valves, tank outlets, towers and packing, and fans. Excellent service.

3. One chemical plant is using Duriron equipment on all concentrations of nitric acid at various temperatures including strong nitric at a very high temperature. They have not found any nitric acid condition for which Duriron is not suitable.

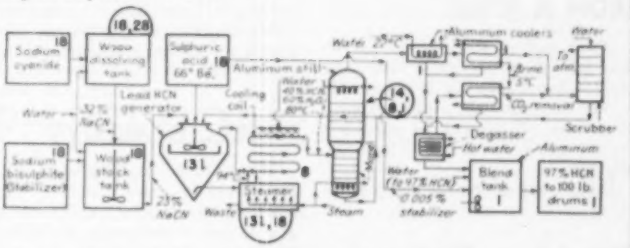
Hexachlorbutadiene



Hydrochloric Acid



Hydrocyanic Acid



Key: Materials of Construction

1. Aluminum	11. Impervious Graphite	21. Type 316
2. Brick	12. Iron	22. Type 317
3. Bronze	13. Lead	23. Type 347
4. Carbon Steel	14. Monel	24. Type 430
5. Cast Iron	15. Nickel	25. Stoneware
6. Chemical Lead	16. Rubber	26. Tile
7. Concrete	17. Silica	27. Tygon
8. Copper	18. Steel	28. Wood
9. Glass	19. Stainless Steel	
10. High Silicon Iron	20. Type 304	

a = alloys; l = linings (with steel backing in almost all cases); r = refractory lined; O meter als used in combination; two numbers: either material may be used.

4. Many fertilizer plants use Durion valves for handling nitrate solutions since they are more economical than iron based on a number of years experience.

Since no advantage in nitric acid is obtained by using the special high-silicon iron, Durichlor, no mention has been made of this alloy.

—Walter A. Luce

GLASS LINING

Glass-lined steel chemical equipment is quite commonly used in processes using all concentrations of nitric acid at room and elevated temperatures. Closed and open jacketed units are used in numerous nitration processes. Some units as large as 3,000 gal. have been made for the storage of nitric acid solutions.

—S. W. McCann

Rates of attack on a good grade of acid resisting glass:

Acid Weight %	Mils Per Year Room Temp.
2	0.01
5	0.01
10	0.01
20	0.03
40	0.01
60	0.01
72	0.01
	Boiling—Reflux Tests
5	0.28
20	1.20
40	0.01
69	0.09
	160 deg. F.
Red fuming	1.7
White fuming	0.4

IRON & STEEL

Nitric acid solutions up to 75 volume percent corrode iron or steel quite rapidly, hence their use in this service is not recommended. Concentrated nitric acid (95 percent) is much less corrosive, and iron or steel is occasionally used.

If the water content is under 3 percent and a minimum of 5 percent sulphuric acid is added, the corrosion rate is considerably decreased. As the percent of sulphuric increases, the amount of water may also be increased to a maximum of approximately 25 percent.

Steel tanks, pipe, and cast iron pumps, valves, and fittings are frequently used to store and handle these relatively dry mixed acids at atmospheric temperatures and low velocities, where the presence of iron salts in the acids is not objectionable. Some difficulties with cast iron cracking have been experienced where extremely dry mixed acids were used. For handling mixed acids at high velocities or temperatures, or in dilute solution, use of iron and steel is not recommended.

—Albert W. Spitz

LEAD

Lead nitrate which forms on lead upon contact with dilute nitric acid is too soluble to afford adequate protection; however, in concentrations of over 80 percent, lead can be used with little corrosion. Dilute acids cause corrosion at a rate to make practical use of lead questionable. Mixed acid (sulphuric and nitric) may be used with lead at ordinary temperatures if the water present is under 30 percent. Lead is also used with Koch Acid Reduction Mass. This consists of a mixture of naphthylamine—3, 6, 8—trisulphonic acid along with strong sulphuric acid and residual nitric acid from nitration. Corrosion tests on partially or completely reduced mass showed that lead may be used safely in contact with it.

—Kempton H. Roll

NICKEL & ALLOYS

Monel, nickel and Ni-Resist alloys are subject to severe attack by nitric acid and usually are not used with this acid except in extremely dilute solutions.

Inconel, because of its chromium content, is more resistant to nitric acid than any of the above materials. It is particularly resistant to nitric acid concentrations higher than about 20 percent and below about 3 percent at atmospheric temperature. Ordinarily it would not be used at elevated temperatures except in the dilute solutions formed by hydrolysis of some acid nitrate salts. For example, Inconel is used with water solutions of silver nitrate and ammonium nitrate at somewhat elevated temperatures. Inconel commonly is used for baskets and other parts in the pickling of brass parts in cold nitric acid solutions.

—W. Z. Friend

RUBBER LINING

Concentrations of nitric acid up to 5 percent can be handled at room temperature by semi-hard and flexible ebonite stocks. Concentrations up to 10 percent at room temperature can be handled by specially compounded ebonite compositions.

Soft butyl rubber compounds will withstand a solution of 40 percent acid at temperatures up to 120 deg. F. or lower concentrations at slightly higher temperatures. Special butyl composition linings have recently been developed, however, which will handle 50 percent nitric at 140 deg. F.

These butyl linings can be applied to process and storage tanks, pipe, fittings, valves and duct-work. They are applied in the form of unvulcanized sheets which can be worked over irregularly shaped surfaces and after vulcanizing in place, a solid, continuous, protective layer is formed which is tightly adhered to the metal surface.

In view of this, butyl covered metal should now be seriously considered as a material of construction for all applications involving exposure to nitric acid within the limitations outlined above.

—J. P. McNamee

SILICONES

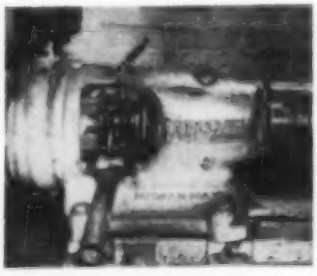
Silicone Fluids—All of the silicone fluids tested had good resistance to dilute nitric acid at room temperature. All except the Dow Corning 710 Fluid showed good resistance to dilute nitric acid at 100 deg. C. The Dow Corning 200 type fluids showed relatively little change in viscosity after seven days exposure to concentrated nitric acid at room temperatures. None of the fluids tested were resistant to concentrated nitric acid at 100 deg. C.

Silastic—The best Silastic stocks are 180 and 181 which were developed especially for use as gasket materials of low compression set and good chemical resistance.

Silicone Greases—Of particular interest is the nitric acid resistance of the Valve Seal A which designed for pressure lubricated valves and flow meter bearings. Lubricant is rated as good in contact with dilute nitric acid at room temperatures or at 100 deg. C. Laboratory tests indicate that the resistance of this silicone grease to concentrated nitric acid is poor compared to its resistance to 10 percent nitric acid; but even so it should give better service than organic lubricants under such drastic service conditions.

Silicone Resins—Typical samples of three silicone resins, namely the electrical varnishes Dow Corning 993 and 996, and the laminating resin Dow

Materials at Work:



DURIMET vs. NITRIC ACID
Durimet pump handling 30 deg. Be. nitric acid for absorption tower.

Corning 2103, were exposed to dilute and concentrated nitric acid at room temperature and at 100 deg. C. No samples showed any significant change in weight or appearance after seven days of immersion in dilute nitric acid at room temperatures or at 100 deg. C; Dow Corning 2103 showed good resistance to concentrated nitric acid at room temperature and at 100 deg. C. After seven days in concentrated nitric acid at 100 deg. C. samples of 2103 were unchanged in size or appearance, but when broken the resin was powdery showing that the bonding strength had been affected.

—J. A. McHard

STAINLESS STEEL

Stainless steel grades in both the 400 series (straight chromium) and 300 series (chromium-nickel) are very resistant to all concentrations of nitric acid at practically all temperatures. They are used for chemical processing equipment such as storage tanks, reaction vessels, condensers, and screens. The successful development of the ammonia oxidation process was based upon the corrosion resistance of stainless steel which is used extensively throughout the system, especially in the absorption towers. Additional common applications are heat exchangers, valves, pumps and pipe lines. Similar equipment is practically indispensable in the numerous other industries which depend wholly or in part on the satisfactory handling of nitric acid.

Where nitric acid solutions of any concentration are involved at room temperature, all of the stainless steel grades exhibit satisfactory corrosion resistance, and selection of material is determined by physical requirements.

Average typical corrosion rates for the various superior grades immersed in boiling 65 percent nitric acid solution for five periods of 48 hr. each are shown below.

Type	Corrosion Rate Mils per Yr.
430	<60
304	<12
347	9.6-14.4
308	<12
309	<12
309 Cb	4.8- 8.4
310	<12

Various mixed acid solutions containing nitric acid are safely handled in stainless steel equipment. Nitric-sulphuric acid mixtures of many concentrations are commonly used in contact with Types 430, 446, 304, and 347. Also, certain mixtures of phosphoric, acetic, or other acids with nitric acid do not attack stainless steel. Mixtures of nitric acid with either hydrochloric or hydrofluoric acid are corrosive to all of the stainless steel grades, the extent of attack depending upon the acid concentrations and the solution temperatures. Nitric-hydrofluoric acid baths are regularly used for descaling stainless steel.

Types 430 and 309 have proved to be well suited for exposure to the gaseous oxides of nitrogen at elevated temperatures as well as room temperatures.

All of the principal stainless steel grades are available in both the cast and wrought forms. At least one of the stainless steel grades will meet the corrosion resisting and physical requirements for most nitric acid applications.

—Grant L. Snair, Jr.

STONEWARE

Chemical stoneware is completely resistant to attack at all temperatures and concentrations.

One of its widest uses is in the manufacture of recovery towers for recovering nitric acid from the manufacture of nitroglycerine.

Wherever nitric acid is handled, and especially in combination with other chemicals such as in aqua regia, chemical stoneware is used. Gold refining plants use chemical stoneware kettles, evaporating dishes, duct work and exhausters in this type of application.

To draw a conclusion, it may be said that chemical stoneware is one of the few materials of construction which is resistant to nitric acid at all concentrations and temperatures and is, therefore, utilized for all of the possible items of chemical equipment such as towers, reaction and storage vessels, pumps, piping, and valves.

—F. E. Herstein

TANTALUM

Tantalum is completely inert at all concentrations and temperatures. In fact, the concentration of nitric acid, and the distillation of C.P. nitric acid from crude are two important applications of tantalum equipment.

—Leonard R. Scribner

WORTHITE

Worthite is suitable for all strengths of nitric acid up to fuming acid, at fairly high temperatures. It can successfully handle cold fuming acid in connection with the manufacture of rocket fuels. It is supplied in pumps, valves, bars and screw machine products.

Worthite is suitable for temperatures up to near the boiling point for commercial concentrated HNO_3. It gives good resistance in the Huey test: 65 percent HNO_3 at boiling. The exact upper temperature limits in the fuming acid are not yet known but it is believed 120-125 deg. F. may be close to the practical limit.

Worthite pumps are in service in all types of plants using nitric acid such as explosives, plastics, organic synthesis, dyes, pigments, and nitrates.

Corrosion rates on commercial nitric acid are negligible in all cases. At room temperatures corrosion rate in red fuming nitric is negligible.

—W. E. Pratt

PHOSPHORIC ACID

ALUMINUM

Since H_3PO_4 solutions are inherently somewhat corrosive to aluminum alloys, use of aluminum for processing equipment for this chemical is not generally recommended unless protective coatings are provided or unless the acid is suitably inhibited.

—Ellis D. Verink, Jr.

CARBON

Amorphous carbon, graphite and Karbate are inert to ortho-phosphoric acid in all commercial concentrations. Carbon has long been used in phosphorus electric furnaces, H_3PO_4 precipitators and ducts, and towers for absorbing P_2O_5 vapors in water. There is no evidence of attack by phosphorus compounds on carbon (except a slow solution of furnace bottoms in unsaturated ferro-phosphorus). Actually, H_3PO_4 deposits on carbon protect it from oxidation and permit operation considerably above 350 deg. C.

Top temperature limitation on Karbate is 170 deg. C. But by proper equipment design it can be operated in P_2O_5 flue gases without damage. Graphite is used as the burner chamber for producing P_2O_5. Temperatures are held below oxidizing temperatures in excess air (450 deg. C.) by water cooling.

Karbate can handle acid up to 85 percent strength at atmospheric boiling point. Its uses: in acid pumps, valves and piping; for cooling all concentrations of H_3PO_4; heating solutions such as those for rust-proofing steel.

Contamination of the H_3PO_4 by fluorides, sulphates, HF or H_2SO_4 has no corrosive effect.—L. C. Werking

CHLORIMETS

Good resistance; used successfully in equipment handling H_3PO_4. Chlorimet 2 has a high degree of corrosion resistance for all strengths and temperatures of the relatively pure acid. Chlorimet 3 is comparable except for hot, concentrated acid. Superior resistance of Chlorimet 2 apparently includes 117 percent acid up to several hundred degrees F.

Oxidizing impurities in crude wet acid greatly increase the corrosion rate on Chlorimet 2, less so on Chlorimet 3. Small quantities of HF do not make these alloys unsuitable for handling H_3PO_4.

Chlorimets are not commonly used for handling H_3PO_4; other suitable materials cost less. But Chlorimets are used for the acid in the presence of other chemicals destructive to the cheaper alloys. Example: Chlorimet 3 for portable equipment to handle a variety of concentrated acids at normal temperatures. One manufacturer found Chlorimet 2 the best available alloy for a combination of H_3PO_4 and HCl at elevated temperatures.

—Walter A. Luce

COATINGS

Thin film coatings should be avoided; if perforations occur for any reason, the base metal may be attacked at once.

Any acid-resistant commonly used organic corrosion barriers is suitable for H_3PO_4 up to 85 percent strength. Suitable up to 350 deg. F.: carbon or asbestos filled, or glass fabric laminated phenolics or furans. For temperatures up to 150 deg. F.: polyvinyl chloroacetates, vinylidene chlorides, all rubbers except thiokol, polyethylene and its derivatives and polystyrenes.

—Kenneth Tator

Materials at Work:



WORTHITE vs. PHOSPHORIC ACID
Worthite pump handling monocalcium phosphate containing approx. 30 percent phosphoric acid, at 122 deg. F.

DURIMET 20

Gives excellent service with H_3PO_4 containing small amounts of fluorides and abrasive gypsum, such as produced by the wet process. Also widely used to handle H_3PO_4 containing other chemicals or salts corrosive to 18-8 SMo.

Especially used for pumps, agitators and valves where corrosion may be more rapid.

—D. E. Jack

DURIRON

Pure phosphoric acid gives a tough, tenacious silicon oxide film that makes this alloy corrosion resistant to the acid. High-silicon iron can be recommended for pure H_3PO_4 at all concentrations and temperatures.

Silicon iron is attacked by the HF, silicon fluoride or other fluorine compounds invariably found in crude, wet-process acid. This holds regardless of the strength or temperature of the crude acid. However, silicon is still widely used for wet-process H_3PO_4—probably because of its excellent resistance to abrasion and erosion.

—R. M. Shields

GLASS LINING

Glass-lined equipment should not be used for handling H_3PO_4 that contains even traces of soluble fluorides, either at room or elevated temperatures. The rate of attack is accelerated as temperature goes up.

Glass-lined equipment can be used successfully with H_3PO_4 that is free of soluble fluorides if the temperatures do not greatly exceed room temperature. It is not recommended for high concentrations of H_3PO_4 at elevated temperatures even if free from soluble fluorides.

At elevated temperatures, glasses Nos. 42, 42PF, and 24 are satisfactory for all concentrations of phosphoric acid up to but not above 40 percent by weight. Above 40 percent and at high temperatures, service life of glass linings will probably be limited to 1-2 years.

—O. I. Chormann

IRON & STEEL

Cast iron and carbon steel are usually not recommended for H_3PO_4 service. Crude acid of 70 percent or greater strength can sometimes be handled in cast iron and carbon steel equipment.

—Albert W. Spitz

LEAD

Widely used in the commercial production and handling of this acid. Impure H_3PO_4 containing H_2SO_4 gives negligible corrosion.

Lead is used with pure acid in concentrations up to 80 percent at 200 deg. C., with impure acid up to 85 percent. Lead-lined wood or steel tanks are very satisfactory for construction of agitators, thickeners, storages, troughs and launders. Where sludges are handled, a lining of acid-resistant brick protects the lead from abrasion and fluorine. Proper design and installation of lead-lined equipment are important.

In some agitators and thickeners, raking blades are of hard lead with grains of aloxite imbedded in the surface; this plumbalum resists abrasion and chemical action. Lead-lined steel pipes are used for operations under pressure. Lead steam coils are used in evaporators for concentrating acid. Homogeneous lead linings may be used in installations where a vacuum is applied.

—H. M. Church

NICKEL & ALLOYS

Generally limited to use with the relatively pure acid made by electric furnace processes. Wet-process acid usually has enough ferric salts to give oxidizing condition that is corrosive to these alloys under most conditions.

Monel is resistant to unaerated pure H_3PO_4 at all concentrations up to about 220 deg. F. Corrosion is appreciable at higher temperatures; yet there is evidence that it has adequate resistance to tetraphosphoric acid with 85 percent P_2O_5 up to 350 deg. F. Aeration increases the attack on Monel in acid of 10-50 percent H_3PO_4.

Nickel and Inconel resist the acid in all concentrations at atmospheric temperature. Corrosion rates are increased by aeration. Hot, concentrated pure acid is very corrosive to both alloys. Inconel often has useful resistance to crude acid solutions at temperatures close to atmospheric—but not higher.

Ni-Resists are usefully resistant to H_3PO_4 solutions only at atmospheric temperatures and when unaerated. Ni-Resist 1 is somewhat more resistant than Type 2.

Monel is used for tanks, heating coils and other accessories handling H_3PO_4 solutions used for surface treatment of metals, for fans and other equipment in absorption towers for phosphorus vaporization processes.

—W. Z. Friend

RUBBER LINING

Extensively used in manufacture and storage of the acid. Principal problem is to prevent the acid from being

discolored. Soft pure rubber stock with special antioxidants are suitable for handling H_3PO_4 up to 85 percent strength and 130 deg. F.

Where slight discoloration is not objectionable, semi-hard rubber stocks can be used up to 180 deg. F. For higher temperatures, it is possible to protect the rubber lining with an inner lining of acidproof brick.

GR-S synthetic rubber has not been satisfactory because of the antioxidant used; special GR-S polymers are now available which should be satisfactory. Neoprene linings are comparable to natural rubber insofar as discoloration of acid is concerned, but price limits use of neoprene somewhat. Butyls do not discolor and give satisfactory test results. But natural rubber linings continue to be the most common ones in industrial processes. —O. S. True

SILICONES

Commercial silicone products show remarkable resistance to phosphoric acid. Concentrated acid does not attack them at room temperatures; dilute acid is without effect at 100 deg. C. Concentrated acid degrades the elastomers and resins at 100 deg. C.

Laboratory resistance tests indicate that silicone fluids are not radically affected at room temperature or at 100 deg. C. Mixed alkyl and aryl polysiloxane fluids show less resistance to concentrated acid than straight methyl polysiloxanes. Viscosity increased.

Silicone grease is used successfully as a lubricant in valves handling H_3PO_4 at 230 deg. C. Silicone elastomers are not affected by acid of any concentration at room temperature. At 100 deg. C. the concentrated acid severely degrades the polymer.

Resistance of silicone resins is comparable to that of the elastomers. They show good resistance to dilute and concentrated acids at room temperature and to dilute acid at 100 deg. C. They were badly crumbled by concentrated H_3PO_4 at 100 deg. C.

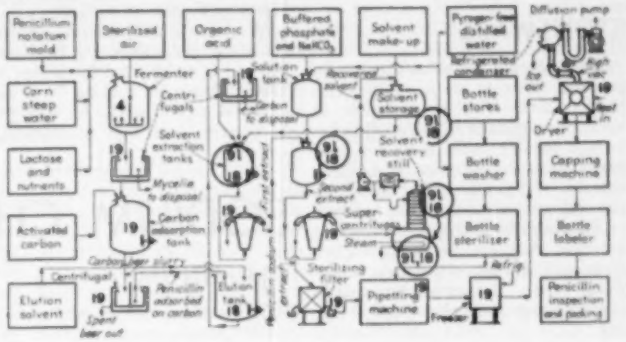
—J. A. McHard
J. T. McIntyre

STAINLESS STEEL

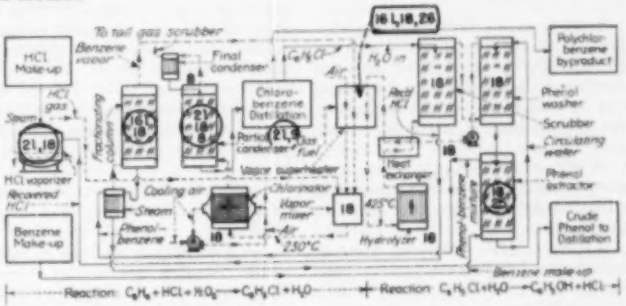
Types 304 and 316 are widely used for phosphoric acid. Type 304 is used for equipment in the blending and mixing of soft drinks containing this acid.

Resistance of stainless steels to 60 percent wet-process acid depends on the HF and free H_2SO_4 present. In absence of appreciable amounts of HF, Type 316 has a low corrosion rate when 1-2 percent free H_2SO_4 is present at temperatures as high as 180 deg. F.

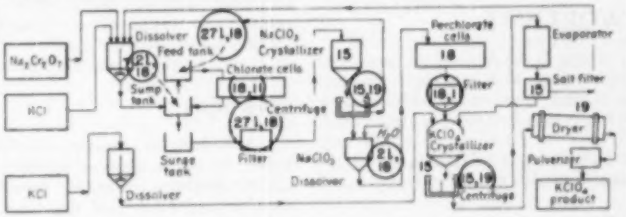
Penicillin



Phenol



Potassium Perchlorate



Key: Materials of Construction

1. Aluminum	11. Impervious Graphite	21. Type 316
2. Brick	12. Iron	22. Type 317
3. Bronze	13. Lead	23. Type 347
4. Carbon Steel	14. Monel	24. Type 430
5. Cast Iron	15. Nickel	25. Stoneware
6. Chemical Lead	16. Rubber	26. Tile
7. Concrete	17. Silica	27. Tygon
8. Copper	18. Steel	28. Wood
9. Glass	19. Stainless Steel	
10. High Silicon Iron	20. Type 304	

a = alloys; l = linings (with steel backing in almost all cases); r = refractory lined; O materials used in combination; two numbers: either material may be used.

It is used in tubular evaporators in concentrating the acid under reduced pressure and at about 180 deg. F.

Type 316 is used in practically all phases of the manufacture of high-purity acid made by dissolving P_4O_{10} in water. It is also used in the manufacture of many phosphate salts.

General summary: Type 304 is satisfactory for handling all solutions of

pure H_3PO_4 below 212 deg. F., Type 316 for equipment operating below about 230 deg. F. —G. L. Snair, Jr.

STONEWARE

Like other silica-containing compounds, reacts to some extent with H_3PO_4. Since this is negligible at ambient temperatures, chemical stoneware is suitable under these and ordinary industrial conditions. If temperature does not greatly exceed 80 deg. C. any acid concentration can be handled.

Stoneware used largely in handling —rather than manufacturing—operations and equipment: pumps, cylindrical vessels, rectangular tanks, both conical flange and bell-and-spigot piping. —F. E. Herstein

TANTALUM

Inert to pure acid in any concentration up to 175 deg. C. Not resistant to fluorides in phosphoric acid. If fluorine is below 10 ppm., tantalum can be used for heat transfer surfaces. An appreciable concentration of SO_3 also damages tantalum.

If SO_3 or fluorine are absent, aeration, concentration or other impurities (such as arsenic) have no effect on tantalum.

Typical uses: tantalum bayonet heaters for low-fluorine acid in processing to remove impurities; heaters for production of food-grade acid.

—F. L. Hunter

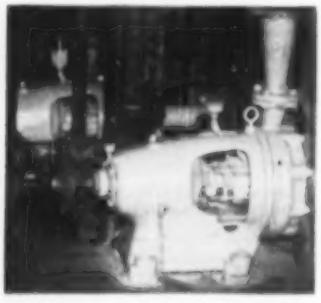
WORTHITE

High Ni-Cr-Mo alloys are more economical than stainless for concentrated solutions at high temperatures, especially if these contain H_2SO_4, fluorine or fluorides. Worthite used for all strengths of H_3PO_4 up to 250 deg. F. (with or without H_2SO_4 and HF) and with high percentages of solids in suspension. Tests with aerated pure acid of 5, 40 and 70 percent at 176 deg. F. showed no loss.

Worthite is an economical material for crude acid containing H_2SO_4 and HF and is widely used for pumps and valves. One plant making "wet process" acid uses Worthite for acid up to 75 percent (with high percentages of abrasive solids in suspension) and at 205 deg. F. Another uses centrifugal pumps for delivering the slurry or "mud" to filters. Solids run to 65 percent by volume, temperature is 130-140 deg. F., acid is 27 percent. Rubber-lined pumps had a maximum life of about 2 months; Worthite pumps are giving good service after 3 years.

—W. E. Pratt

Materials at Work:



DURIMET vs. SULPHUR DIOXIDE
Durimet pumps handling suphite cooking liquor ($Ca(HSO_3)_2 + H_2SO_3$).

SODIUM CHLORIDE

ALUMINUM

Satisfactory, except where heavy metal contaminants such as compounds of copper, nickel and lead are used. Area of attack of these, though small, is highly localized. May be minimized by use of duplex product, Alclad, which is effective in preventing most localized failure.

Alloys such as 2S, 3S, 52S and 63S are resistant to brines, virtually unaffected by unpolluted sea water and general weathering in marine atmospheres.

Used for condenser tubes in salt water service, in mining and drying machinery, structural materials in mines and other miscellaneous equipment. Also in preliminary process equipment such as hoppers, elevator buckets and shafts, drying towers. Wooden shipping containers for salt are lined with aluminum sheet to prevent the egress of salt and the picking up of moisture.

—Joseph P. Balash

CARBON

Unattacked by sodium chloride, either dry or in aqueous solution at all temperatures. Karbate products may be used up to 340 deg. F.

Most extensive use: graphite anodes in caustic-chlorine cells where, although there is a slow oxidation due to the products of electrolysis, there is no attack by the sodium chloride itself. Graphite anodes also used in cathodic protection systems for condensers and pipelines in sea water and salt marsh conditions. Used in heat transfer equipment including concentric, bayonet, cascade and shell and tube types. Its inertness to sea water, clean or contaminated, makes it applicable to cooling operations using sea water in such operations as cooling hydrochloric acid, hydrochloric-sulphuric mixtures, phosphoric acid and chlorinated hydrocarbons mixed with hydrochloric.

—L. C. Werking

CHLORIMETS

Chlorimet 3 completely resistant to sodium chloride solutions at all concentrations and temperatures. Also resistant to these solutions with contaminants if contaminants have no effect on this alloy by themselves.

Chlorimet 2 shows excellent resistance to all concentrations and temperatures. Contaminants of an oxidizing nature tend to attack this alloy because of its lack of chromium.

—Walter A. Luce

COATINGS

All of the commonly used organic corrosion barriers are unaffected by sodium chloride brines but there are small differences in performances between each of the materials due to differences in their water absorption or water permeation characteristics. These become significant with decreasing thickness of the protective film and with the presence of any applied force to drive water through the coating film such as by electrolyte action or cathodic protection. Nonpolar materials will be most resistant to such water permeation. Among these are the rubbers, natural and synthetic (except Thiokol and acrylonitrile types), polyethylene and its halogenated derivatives, bitumin hydrocarbons, polystyrene, chlorinated rubber and other hydrocarbon or chlorinated hydrocarbon types. Polyvinyl chloroactetates, although they are not of the same degree of nonpolarity as the preceding materials, offer a surprisingly high resistance to moisture permeation.

—Kenneth Tator

DURIMET 20

Satisfactory for many industrial applications although some tendency to pit under aerated conditions. Some successful applications: gate valves in soap plant handling recirculating sodium chloride at temperatures up to

180 deg. F.; pumps in chemical plant circulating hot, dilute, caustic-neutralized organic solutions which contain appreciable amounts of sodium chloride; equipment for saturated salt brines at temperatures up to 280 deg. F. —Walter A. Luce

DURIRON

High-silicon irons used successfully for many years in applications involving sodium chloride as the corrosive medium. Duriron used for solutions at all concentrations and temperatures. Durichlor (with 3 percent Mo), is more desirable where appreciable amounts of contaminants such as chlorine or hydrochloric acid are present.

Among applications: in processing olives, brine concentrated to 20-30 percent by weight and heated to about 160 deg. F. with Duriron heat exchangers. Duriron pumps and valves also used. In the production of commercial salt, satisfactory service at temperatures as high as 280 deg. F.

Durichlor pumps used successfully in handling a sodium chloride and hydrochloric acid solution in the chlorination of rubber derivatives. Also has proved serviceable in handling chlorinated brine solutions from the cells in an electrolytic chlorine-caustic soda plant. —Walter A. Luce

GLASS LINING

Glass lined steel chemical equipment is entirely resistant to sodium chloride in all concentrations. It has been widely used in the food products industry for handling brines, and in the pharmaceutical field for salt sterilizing solutions.

—S. W. McCann

IRON & STEEL

Cast iron and carbon steel are widely used throughout industry for pumps, valves, tanks and piping, handling natural brine, sea water, and relatively pure sodium chloride solutions. Corrosion generally occurs, but can be kept low enough to make use of these materials practical if iron contamination is not objectionable. Corrosion is accelerated by contact of dissimilar metals, by dissolved air, by stray electrical currents, and by excessive velocities and turbulence.

In addition chemical control is generally used to reduce corrosion in refrigerating brines. This may be accomplished in closed systems by adding an inhibitor, such as sodium dichromate, and adjusting the pH to a value between 8 and 9. For open systems disodium phosphate is recommended with a pH between 7.5 and 8.

Correct design, supplemented by the use of inhibitors and pH control, has been found to reduce corrosion as much as 95 percent.

—Albert W. Spitz

LEAD

Some corrosion, but so slight, (4 or 5 mils per year when exposed to 1N sodium chloride, and practically no corrosion from salt spray), that years of useful life are obtained from lead pipe, valves, boat keels, sinkers, and sheet lead in various forms.

Widely used in aquariums. Shedd Aquarium in Chicago equipped with lead pipes for handling sea water in 1930. The only change at this date is an undisturbed lining of lead oxide or lead oxychloride within the pipes. In another application, lead bars were exposed in Bristol (England) Channel for over four years. The corrosion rates for soft lead and 1.6 percent antimonial lead were less than 0.3 mils per year. There was no localized attack on these bars which were submerged 93 percent of the time.

—H. M. Church, Jr.

NICKEL & ALLOYS

Monel, nickel, Inconel and the Ni-Resist alloys have a high degree of resistance to sodium chloride and brine solutions under practically all conditions of concentration, temperature and aeration. Monel, nickel and Ni-Resist are being used for a great many applications in the production of salt and in its utilization in such processes as soap manufacture, caustic soda and chlorine production, food brining and refrigeration. Applications of Monel in salt production include grainer rakes, drain boards, filers, filter cloth, pump rods and impellers, hoppers, chutes, etc. The usefulness of Monel in a number of these applications results from its resistance to abrasion by crystalline salt as well as to corrosion.

Nickel or nickel-clad steel is used for such equipment as salt dissolving and brine storage tanks, soap lye treating and storage tanks, evaporator tubes and coils in such industries as soap, caustic, and food processing.

The Ni-Resist austenitic cast nickel-iron alloys are used for such equipment as pump casings and impellers, valves and cast pipe handling brines, and for bodies and plates of filter presses and rotary salt filters. Type 1 Ni-Resist (14 Ni, 6 Cu) and Type 2 Ni-Resist (20 percent Ni) usually are used for brine service except where the parts are subject to severe thermal shock. Under such conditions, the relatively high expansion coefficient of these two types may possibly make them subject to cracking, and the use of Type 3 Ni-Resist (30 percent Ni) having low expansion coefficient, is desirable. —W. Z. Friend

RUBBER LINING

Sodium chloride has very little effect on either natural or synthetic rubber and may be handled by either soft or hard linings. Selection of type of lining will be dependent upon service conditions, principally upon operating temperatures.

At high temperatures, heat aging of the lining is the important factor, and the best service life is obtained from specially compounded ebonite formulations. Concentrated solutions of sodium chloride can be successfully handled with compounds of this type at temperatures up to 220 deg. F. Satisfactory commercial installations have been made in crystallization tanks operating at temperatures up to this maximum.

Rubber covered agitator equipment has also been supplied. For services of this type, a tough, carbon black loaded natural rubber composition is usually preferred. Rubber-lined pipe and fittings have been successfully used for recirculation of brines in chlorine manufacture. —O. S. True

SILICONES

Silicones in their various forms generally exhibit good to fair resistance to sodium chloride brine solutions ranging from 5 to 26 percent concentration and from room temperatures to 100 deg. C.

The fluids and the resins showed good resistance in all cases and the Silastic registered good at the higher concentrations, fair at the higher temperatures. —J. A. McHard

STAINLESS STEEL

Chromium-nickel types of stainless steel are resistant to sodium chloride solutions of practically all concentrations and temperatures, provided neutral or alkaline conditions are maintained. Boiling solutions generally can be handled successfully unless the metal is in a stressed condition. The stainless steels usually are not satisfactory for prolonged contact with slurries or supersaturated solutions of sodium chloride. While freshly prepared sodium chloride solutions are neutral, hydrolysis during stagnation establishes an acid condition which

will induce localized attack on stainless steel. Of all the stainless steel grades, Types 316 and 317, the modified grades containing molybdenum, are more resistant than the other grades to the attack by pitting which is characteristic of media containing sodium chloride.

For most of the corrosion resisting services in industrial, food processing, and household applications where sodium chloride is encountered, stainless steel can be employed with highly satisfactory results. A wide variety of equipment includes vats and related apparatus for tanning, dyeing and soap manufacturing and also circulating systems for controlled brines. Corrosion by marine atmospheres and sea water is resisted under most circumstances.

—Grant L. Snair, Jr.

STONEWARE

Impervious to the action of sodium chloride, both dry and in solution, and at all concentrations and temperatures. Chemical stoneware piping and pumps can be used for handling brine solutions and at least one installation of stoneware for handling chlorinated brine from chlorine cells is known. An interesting application is in the pumping of sea water to aquariums. Several of these applications are contemplated. Stoneware not widely used because other equipment is more readily available and in some cases more economical.

—F. E. Herstein

TANTALUM

One of few metallic materials not attacked at all by aqueous solutions of sodium chloride at any concentration or temperature under atmospheric pressure. Mixtures of other substances of an acidic nature with sodium chloride rarely have any effect on tantalum, although solutions containing fluorides or substances which hydrolyze to alkalis may attack tantalum.

Tantalum is recommended as a material for heat exchangers, heaters, coolers or condensers in operations, pharmaceutical or C.P. preparations where there must be no contamination of product due to metallic corrosion. A tantalum brine cooler of the shell and tube type has been in service nearly five years and has proved to be an effective solution to the troublesome problem of free chlorine in solution. This condition is usually found in chlorine-alkali cells and associated equipment where heated brine containing free chlorine becomes sufficiently destructive to constitute a corrosion problem of real magnitude in brine coolers.

—Leonard R. Scribner

WORTHITE

Resistant to all conditions except highly acid conditions at high temperatures.

An economical application for Worthite pumps and valves is in the handling of hot salt slurries in salt refineries where the evaporator pan carries about 50 percent salt crystals at an average temperature of 160 deg. F. These pumps have given 11 years' service to date without requiring any repairs.

—W. E. Pratt

Materials at Work:



DURIRON vs. SULPHURIC ACID
High-silicon iron pump circulating 35-40 percent H_2SO_4.

SULPHUR

ALUMINUM

Excellent resistance to solid, molten and vapors. Experimental shipments of solid sulphur and sulphur-bearing ores and coals in aluminum freight cars revealed no appreciable corrosion, while ordinary freight cars showed considerable corrosion. Tests in molten sulphur at 410 and 770 deg. F. showed no attack. Although boiling sulphur and sulphur vapors have no affect on aluminum, aluminum's low melting point (1,218 deg. F.) eliminates it for sulphur boilers and the like.

—James R. West

CARBON

Sulphur has no corrosive effect on carbon, graphite or Karbate impervious carbon and graphite. Under reducing conditions carbon and graphite are applicable at all commercial temperatures, while the limits in air are the threshold oxidation temperatures of 660 deg. F. for carbon and 750 deg. F. for graphite. Karbate is limited to 340 deg. F.

Porous carbon filters are extensively used to remove solid impurities and dirt from molten sulphur prior to atomizing and burning.

Melting solid sulphur with indirect steam coils is a problem in many plants; a pilot installation of a Karbate plate type heat exchanger for this service is now in operation.

—R. O. Joslyn

CHLORIMETS

Data on resistance of Chlorimets 2 and 3 to molten sulphur extremely limited but there is definite reason to suppose their high alloy content would provide excellent resistance up to high temperatures. However, they have the disadvantages of high cost and availability only in cast form. Therefore they have found no commercial application in sulphur handling.

—Walter A. Luce

COATINGS

There is little or no call for organic protective coatings for sulphur in its lump or powder form. Because it melts at temperatures in excess of 230 deg. F., none of the rubbers or thermoplastics can be used for molten sulphur. The thermosetting phenolics and furans will, up to 300 deg. F., satisfactorily resist molten sulphur and the superheated steam often used as heating or transport medium. Over that temperature refractories or alloys should take over.—Kenneth Tator

DURIMET 20

Good resistance to molten sulphur to temperatures well above melting point. Moisture definitely increases corrosion rate, but aeration does not have same noticeable effect as with chrome-free alloys.

Tests indicate 18-8 stainless and Durimet have about equal resistance to molten sulphur; presence of moisture does not seem to alter this relationship. However, practical experience indicates Durimet superior for high velocity conditions as in pump. Some applications: Durimet impellers have improved life of cast iron pumps handling moisture-free molten sulphur. All-Duriron pumps used in presence of moisture. All-Durimet pumps han-

dling over 40 tons molten sulphur per day for one company. Tubing made of Carpenter 20 (wrought form of Durimet 20) used to overcome liquid line corrosion on steel riser pipe for steam heaters. —WALTER A. LUCE

DURIRON

Good resistance to molten sulphur but limited in application because of susceptibility to thermal shock and because of acceptable resistance of plain cast iron and steel. Despite these limitations, Duriron kettles have been used to melt sulphur; sharp temperature fluctuations were avoided and at least one kettle shows no sign of corrosion after one year's continuous operation. —WALTER A. LUCE

GLASS LINING

While glass lined steel is fully resistant to sulphur in the solid, liquid or gaseous state, it is not ordinarily called upon to handle it in the elemental state. —S. W. MCCANN

IRON & STEEL

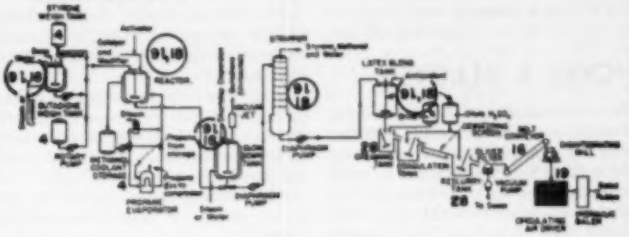
May be used to handle solid and molten sulphur up to 350-400 deg. F. provided air and moisture are rigorously excluded. Satisfactory service reported from cast iron pumps submerged in molten sulphur at 350 deg. F. and from steel tanks containing molten sulphur. Black iron pipelines carrying molten sulphur 12 yr. still in good shape.

Effect of moisture: Causes rapid corrosion of steel even at room temperature. Tests at 100 deg. F. showed corrosion rate of 1 mil per yr. in sulphur containing 0.5 percent moisture, 15 mils at 6.4 percent moisture, 400 mils at 20 percent moisture. Addition of ammonium bicarbonate (50 lb. per ton) to sulphur containing 20 percent moisture reduced corrosion by 50-90 percent.

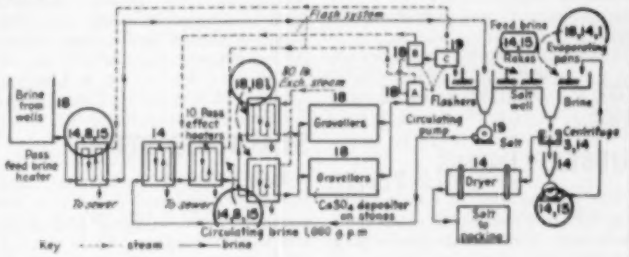
Effect of aeration: Aeration of molten sulphur at 260 deg. F. increased corrosion of cast iron from 8 mils per yr. to 45, of steel from 3 mils per yr. to 47. Cast iron and steel equipment handling molten sulphur with otherwise reasonable maintenance often shows excessive corrosion at liquid level.

Effect of temperature: Tests on cast iron in molten sulphur showed corrosion rates of less than 1 mil per yr. at 260 deg. F., 27 mils at 500 deg. F., 400 mils at 830 deg. F. Metallizing with aluminum or chromium raises temperature limit for steel: Metal spraved tubes were satisfactory in a condenser where sulphur vapors entered at 832 deg. F. (cooling water entered at 80 and left at 190 deg. F.). —JAMES R. WEST

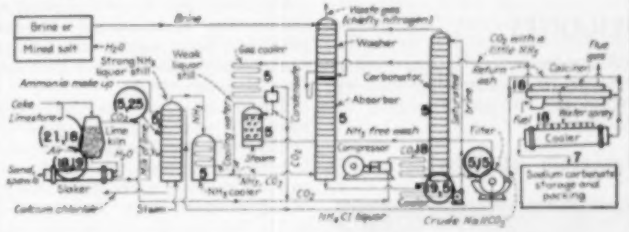
Rubber (GR-S)



Salt



Soda Ash



Key: Materials of Construction

1. Aluminum	11. Impervious Graphite	21. Type 316
2. Brick	12. Iron	22. Type 317
3. Bronze	13. Lead	23. Type 347
4. Carbon Steel	14. Monel	24. Type 430
5. Cast Iron	15. Nickel	25. Stoneware
6. Chemical Lead	16. Rubber	26. Tile
7. Concrete	17. Silica	27. Tygon
8. Copper	18. Steel	28. Wood
9. Glass	19. Stainless Steel	
10. High Silicon Iron	20. Type 304	

a = alloys; l = linings (with steel backing in almost all cases); r = refractory lined; O materials used in combination; two numbers: either material may be used.

LEAD & OTHERS

Lead reacts readily with sulphur; ignites in sulphur vapor.

Cadmium used successfully in plants processing sulphur, one manufacturer reporting better service from cadmium plated equipment than from chromium plated in handling sulphur dust.

Manganese showed a corrosion rate of only 2 mils per yr. in molten sulphur at 750 deg. F. Alloying with 20 percent copper increased rate to 9 mils per yr.

Chromium. No quantitative data available but a great deal of chrome-plated equipment is operating satisfactorily exposed to sulphur and sulphides at various temperatures.

Copper is completely unfit for handling molten sulphur, and its alloys, while quite resistant compared to copper itself, leave much to be desired.

—James R. West

NICKEL & ALLOYS

If air is excluded, nickel and Monel are quite resistant to molten sulphur up to 575 deg. F. Corrosion increases sharply above this temperature. Inconel is reported good up to 690 deg. F. Ni-Resist is no more resistant to molten sulphur than plain cast iron. In unaerated molten sulphur the corrosion rates below were observed.

—James R. West

	At 565 Deg. F.	At 825 Deg. F.
	Corrosion Rates, Mils Per Yr.	
Nickel	13	1,210
Monel	20	1,360
Inconel	6.8	24
Ni-Resist	131	592

RUBBER LINING

Very seldom used in contact with solid sulphur although they would be satisfactory. They should not be used in contact with molten sulphur.

—J. P. McNamee

SILICONES

Laboratory tests in molten sulphur at 250 deg. F. indicate good resistance by all of the silicones. To wit:

Two representative silicone fluids showed practically no change in viscosity after seven days exposure.

Four silicone rubbers showed no significant change in weight, volume, hardness or elasticity after seven days exposure.

Three electrical insulating varnishes seemed to absorb small amounts of sulphur so that those which had been clear became cloudy. Visually there was no apparent change in size.

Two coating resins showed no apparent change in size or in physical appearance.

Field reports indicate that the silicone grease, Dow Corning Valve Seal A, is a superior lubricant for valves handling sulphur and sulphur dichloride at a temperature of 410 deg. F.

—J. A. McHard
J. T. McIntyre

STAINLESS STEEL

After studying data from many sources it is apparent that almost any generality could be disputed by someone with an exception. These then are what appear to be majority opinions, not hard and fast facts.

Up to 400 deg. F. all conventional chrome and chrome-nickel stainless steels resist liquid sulphur but at those temperatures plain iron and steel are generally good enough.

Between 400 deg. F. and the boiling point, 17 percent chrome steel or stabilized 18-8 will probably be satisfactory, but higher alloys will be required at or above the boiling point, as in sulphur boiler tubes. For instance, in the vaporization of sulphur one company has obtained successively better service from Type 304 aluminized, Type 347 aluminized, and Type 310.

For vapor service between the boiling point and about 1,300 deg. F., three alloys—25Cr-20Ni, 27Cn, 27Cr-3Al—can all be expected to give good service. Opinion seems to rank their resistance good-better-best in the order given, but no one of them has consistently proved best for all investigators. And unfortunately the straight chrome and especially the chrome-aluminum show a tendency toward increasing brittleness with increasing alloy content.

—James R. West

STONEWARE

In its usual applications stoneware is not heated above 300 deg. F. and up to that temperature it is not attacked by sulphur.

—James R. West

TANTALUM

In the solid and molten stage up to the boiling point, no attack on tantalum has ever been observed. It has been reported however that boiling sulphur and hot sulphur vapor tarnish tantalum, cause it to become springy and cause loss of weight.

—Leonard R. Scribner

WORTHITE

Not attacked by sulphur in the solid, molten or vapor state. Since cast iron and steel commonly used for handling sulphur it is believed there will be a limited application for Worthite.

Worthite has proved economical for sulphur burning nozzles but corrosive agent in this case is probably sulphur dioxide rather than sulphur itself. Ability to stand the erosion is an advantage of Worthite however.

—W. E. Pratt

Materials at Work:



LEAD vs. SULPHUR DIOXIDE
Cast lead gas fan handling SO_2 for use in acid pulping.

SULPHUR DIOXIDE

ALUMINUM

Oil producers and refiners have found aluminum attractive because of its resistance to sour crudes which often contain high concentrations of sulphur compounds. Tank roofs in sour crude areas are still in excellent condition after 20 years' service. Aluminum equipment has been used successfully for removal of hydrogen sulphide from natural gases, being used for scrubbers, heat exchangers, reactivators, condensers, and piping.

Refrigerating engineers have long recommended the use of aluminum refrigerating systems wherein sulphur dioxide was the refrigerant. Aluminum will also withstand the corrosive conditions encountered in sulphur dioxide towers used in the refining of corn products. The beer industry has chosen aluminum for its resistance to sulphur dioxide.

Aluminum alloys display excellent resistance to corrosion in atmospheres contaminated with the combustion products of sulphur bearing fuels.

—Ellis D. Verink, Jr.
R. H. Wagner
R. H. Brown

CARBON

For all practical purposes, carbon, graphite and Karbate may be used as,

or in, all types of equipment subject to sulphur dioxide and sulphurous acid in all concentrations without fear of corrosion.

Carbon and graphite elements are used in wet flue gas scrubbers for powdered fuel boilers. Graphite bubble caps and trays are used in columns handling SO_3 plus low concentrations of H_2SO_4—subject to occasional neutralization by sodium hydroxide. Porous carbon is used for the dispersion of SO_3 containing low concentrations of SO_3. —L. C. Werking

CHLORIMETS

The chromium bearing Chlorimet 3 alloy exhibits excellent resistance to moist and dry sulphur dioxide, sulphurous acid and the various sulphites. This same high degree of corrosion resistance extends to all temperatures normally encountered. Although the Chlorimet 2 alloy also shows excellent resistance to the moist and dry gas, it does not exhibit the same good resistance as Chlorimet 3 to all sulphurous acid conditions. For instance, it has been determined that a relatively high corrosion rate can be expected at temperatures of about 150 deg. F. and would render the alloy unsuitable for chemical equipment.

Since sulphur dioxide, sulphurous acid and sulphite solutions can normally be handled successfully by stainless steels, either the conventional 18-8-S types or the more highly alloyed Durimet 20 type, the more costly Chlorimet alloys are normally not used for handling these corrosives. Chlorimet equipment, however, has been used in the severe services where sulphurous acid is encountered as a contaminant. It is for these specialized conditions that the Chlorimet alloys find application.—Walter A. Luce

COATINGS

The commonly used organic corrosion barriers are not chemically or physically altered by contact with this gas, either dry or in aqueous solution, but their performance is profoundly affected by the ability of this material to permeate the barrier material and attack the underlying metal. Such permeation is slow but definite and will usually result in loss of adhesion of the organic film to its metallic base. The rate of such permeation is accelerated by increasing temperatures and pressures, consequently the usual maximum temperature limitations of each of the organics are lowered by approximately 30 deg. F. for the thermoplastics and approximately 100 deg. F. for the thermosetting materials when used with sulphur dioxide solutions.

While all of the usual organic corrosion barriers have been used with varying degrees of success in sulphur dioxide service, the hard rubbers are far superior to all soft rubbers and are in long successful use in sulphite liquor lines in the paper industry. The thermosetting phenolics and furans seem to be more dependable than the thermoplastics and are the base for the acid brick mortar joints used in sulphite digestors.

When sulphur dioxide is under pressure organic barriers will tend to absorb a certain amount of gas to give an equilibrium concentration characteristic of the pressure and type of organic. If the pressure is reduced abruptly disruptive expansion within the barrier material may occur, causing loss of adhesion or continuity. This effect is less significant as lining thickness is decreased.

—Kenneth Tator

DURIMET 20

Although 18-8S and 18-8S Mo stainless steels are recognized as being satisfactory for pure H_2SO_3, the fact that some H_2SO_4 may be present because of air oxidation makes an alloy such as Durimet - 20 advisable.

Durimet equipment is being used in the following typical industrial applications:

1. Centrifugal pumps for tower circulation and transfer service in sulphite pulp mills.
2. Fan handling dry 10 percent SO_2 gas at 230 deg. F.
3. Spray nozzles in SO_2 gas cooling and scrubbing towers; gas temperature 750-900 deg. F. with cooling water at 125 deg. F.; weak H_2SO_4 formed due to SO_3 in burner gas.
4. Fan runner delivering approximately 14½ percent SO_2 gas at 75-85 deg. F. with occasional traces of sulphuric acid due to SO_3 gas and moisture present.
5. Manhole sleeves, steam coil sleeves, blowoff connections, etc., on Mitscherlich digestors in sulphite mill. Sulphurous content as high as 6 percent at temperature of 275 deg. F.
6. Top and bottom fittings such as liner sleeves, relief strainers, cover liners, valves and blowoff crosses for vertical sulphite digestors.
7. Target plates for protecting walls of blow pits in sulphite pulp mills.

—W. A. Watkins

DURIRON

The high-silicon iron alloys, Duriron and Durichlor, show fairly good corrosion resistance to dry sulphur dioxide gas at ambient temperatures. Laboratory data under these conditions show corrosion rates between 5 and 10 mils per year. However, moist sulphur dioxide gas, sulphurous acid and the various sulphites are extremely corrosive to these alloys. For instance, sulphur dioxide gas saturated with moisture at room temperature showed corrosion rates on Duriron and Durichlor in the order of 500 to 1,000 mils per year which is an increase of 100 times over the moisture-free condition.

Therefore, the evident destructive nature of these corrosives make it mandatory that they be avoided, even as contaminants, when using high-silicon iron equipment. Rapid failures of high-silicon iron equipment have occurred due to the presence of moist sulphur dioxide, sulphurous acid and various sulphites.—Walter A. Luce

GLASS LINING

Standard glass-lined steel reactors are used for reactions involving sulphur dioxide gas, wet or dry, and sulphurous acid, with satisfactory results and service life. These reactors are one-piece, welded glass-lined steel units conforming to code requirements, and have a very highly corrosion resistant glass coating. The units are equipped with glass coated agitator and baffles.

—O. I. Chormann

IRON & STEEL

Cast iron and carbon steel are widely used to handle dry sulphur dioxide at any temperature, and sulphur dioxide and water vapor at temperatures above the dew point. It is not recommended for use in SO_2 solutions, as the corrosion rate is extremely high.—Albert W. Spitz

LEAD

Lead suffers practically no corrosive effects from SO_2 gas, whether cold and dry or in hot, moist condition up to 390 deg. F.

Lead ducts and lead lined equipment handle large amounts of hot SO_2 vapors from the roasting of lead, zinc, and iron sulphides. Sheet lead is used in the purification of the hot gas prior to conversion to sulphuric acid.

Lead is used extensively in the manufacture and handling of sulphurous acid for the sulphite paper process (fans, coolers, etc.). Digestor covers and relief lines are usually made of lead.

In the manufacture of potassium

metabisulphite, lead lined neutralizers handle the excess SO_2 encountered.
—H. M. Church, Jr.

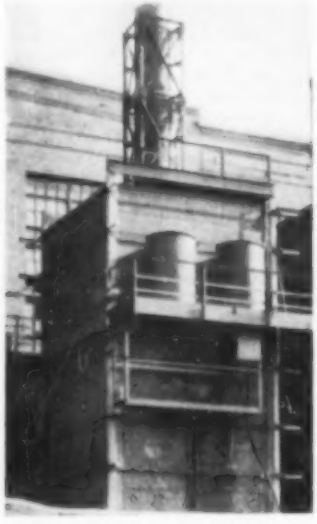
NICKEL & ALLOYS

Nickel and Monel are resistant to dry sulphur dioxide at temperatures up to about 600 deg. F. Above this temperature these materials are subject to intergranular sulphur attack which results in embrittlement. Inconel is resistant up to about 1,500 deg. F. The upper temperature limit for Ni-Resist has not been established. These limits apply also to wet sulphur dioxide gas where temperatures are always well above the dew point of the sulphur dioxide-water vapor mixture. Monel is used for valve and pump parts and miscellaneous fittings in handling anhydrous sulphur dioxide in the refrigeration and other industries. Type 1 Ni-Resist (an austenitic cast nickel-iron alloy, 14 percent Ni, 6 Cu) has been used for gas manifolds and distributors carrying hot mixed gases from sulphur burners to coolers.

None of these materials is resistant to wet sulphur dioxide at temperatures below the dew point of the sulphur dioxide-water mixture, nor in continuous exposure to sulphurous acid solutions containing more than about 0.3 percent SO_2 by weight. There are numerous applications, such as in the handling of steep water and gluten water in corn products plants, where SO_2 contents are low enough that Monel, nickel, and Inconel have good corrosion resistance. In some cases Monel and nickel may show a superficial tarnishing due to SO_2 content and Inconel is superior in this respect.

Monel, nickel, Inconel, and Ni-Resist are not resistant to the strong sulphite liquors encountered in the acid plants, digestors and blow pits of sulphite pulp mills. Ni-Resist has been used to some extent for blow pit pipes. All of these materials have given good performance in handling the washed pulp after discharge from the blow pit. Monel, in particular, is used for such equipment as rotary pulp screens, thickeners, and washers. Ni-Resist is used for pumps, valves, pipe and fittings handling washed pulp and white water. —W. Z. Friend

Materials at Work:



CARBON vs. SULPHURIC ACID
All-carbon electrostatic precipitator resists sulphuric mists.

RUBBER LINING

While rubber lined tanks, pipes and fittings have not found extensive application in SO_2 services, specific compounds of hard rubber have excellent resistance to sulphurous acid up to saturation at atmospheric pressure, and at temperatures up to 150 deg. F. Soft rubber cannot be recommended for SO_2 because of the high rate of diffusion of this gas through such compounds. This diffusion results in failure of the rubber-to-metal bond with subsequent blistering of the lining away from the metal.

SO_2 gas has a more serious effect on soft and semi-hard rubbers than does sulphurous acid. The semi-hard rubbers are softened appreciably by absorption of the gas. The soft rubbers with the exception of butyl are rapidly diffused and blistered under these conditions. It is likely that butyl could be used to good advantage in SO_2 service since it has exceptional resistance to gas diffusion. Actual rate of diffusion of SO_2 through this material has not been determined but exposure tests indicate excellent resistance to both solution of, and permeation or diffusion by the gas.

None of the other synthetic rubbers show advantages over hard natural rubber. —O. S. True

SILICONES

In general, the resistance of various silicone products to both wet and dry sulphur dioxide is good. With the exception of the silicone resins and certain Silastic stocks, the resistance of silicones to sulphurous acid ranges from fair to poor.

The effect of sulphurous acid on silicone fluids has not been determined. The stability of five different types of silicone fluids to wet and dry sulphur dioxide is rated as good.

In general the stability of Silastic stocks to wet and dry sulphur dioxide ranges from fair to good. The resistance of most stocks to sulphurous acid is generally poor, with the exception that Silastic 120 appears to be somewhat improved. J. A. McHard

STAINLESS STEEL

Stainless steel is especially valuable in the pulp-making industry, where sulphite acid liquors containing free sulphur dioxide and an excess of sulphurous acid must be handled in equipment including heat exchangers, digestor circulating systems, digestor relief lines, steam injectors, various tank linings, tie rods, and other related installations. Stainless steel is used also for reaction vessels for combining SO_2 with other substances, for SO_2 absorbers, and for tanks to hold liquids containing SO_2 in solution. Dry gaseous SO_2 and combustion products containing SO_2 are conveyed in tubes, exhaust pipes, flues for roasting furnaces, and stacks for burners using fuel oil or industrial fuel gas.

Stainless steel Types 304, 308, 316, 317, and 329 have been widely used in the sulphite pulp industry. Of this group, Types 316 and 317 are preferred for heat exchangers, digester circulating systems, and relief lines which are exposed to the liquors containing sulphuric and sulphurous acids formed by the combination of sulphur dioxide and water. Where the corrosive conditions are less severe, as in steam injectors and blow pit linings, Types 308, 329, and in certain instances even 304 may be used.

Liquids such as processed fruit juices containing small percentages of SO_2 completely in solution as a preservative are safely stored in tanks made of Type 302 or 304. However, if the saturation limit of the liquid is exceeded in closed tanks, corrosion may occur above the liquid level. Type 316 and Type 317 pipelines, valves, and pump parts provide good service for handling sulphurous acid and solutions containing SO_2.

Type 316 units are suitable for the manufacture of chemical compounds such as sodium bisulphite which is made by bubbling SO_2 through a mixture of soda ash and water, provided that vapors are not inclosed above the liquid level.

Absorbers made of Types 316 and 317 have given satisfactory performance for collecting wet SO_2 gas when operated under properly controlled conditions. —Grant L. Snair, Jr.

STONEWARE

Chemical stoneware is inert to both wet and dry SO_3 and sulphurous acid at all concentrations and all temperatures at which stoneware is commonly used. Its use in handling of these materials is therefore limited only by economic considerations and the extent of thermal shock prevalent in any particular installation involving stoneware equipment.

One of the widest uses of chemical stoneware in connection with SO_3 and sulphurous acid is in the absorption of SO_2 to form sulphurous acid. The packing material for these towers is usually chemical stoneware rings. The piping, circulating sumps, pumps, and other accessories for an SO_2 absorption system can also be made of stoneware.

Chemical stoneware can also be used for any other handling operation involving SO_3 and sulphurous acid at temperatures below 220 deg. F. Where sulphurous acid is used as an anti-chlor in textile plants stoneware piping and pumps are used for handling.

—F. E. Herstein

TANTALUM

Under most circumstances, there are so many materials resistant to wet or dry SO_3 or sulphurous acid that tantalum, because of its relatively high cost, is not necessary.

Where common materials of construction fail, tantalum may be used economically for heaters, coolers, condensers, diaphragms, thermometer wells or other vital parts.

—F. L. Hunter

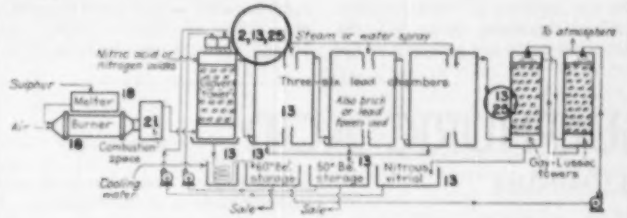
WORTHITE

Stainless alloys of the 18-8S Mo type are acceptable alloys for SO_3 and H_2SO_4 conditions in the sulphite pulp and paper industry. The higher alloyed nickel-chrome-moly alloys such as Worthite have proved more useful when some sulphuric acid is present. If a film of sulphurous acid is left on a surface under shut-down conditions it is possible, with air present, for some oxidation to take place and form H_2SO_4. At the high temperatures encountered in cooling SO_3 gas, Worthite has proved to be superior to the regular chrome-nickel-moly stainless steels.

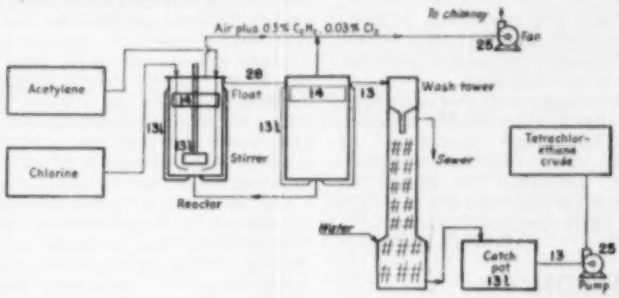
Worthite sulphurous acid tower circulating pumps have given exceptional performance records for a long period of years requiring no repairs. Worthite pumps used circulating sulphite acid at 250 deg. F. in pulp digestion show no signs of corrosion despite long period of useful service.

Where smelter gas is used for the manufacture of sulphuric acid (instead of burning sulphur or pyrites) that gas is usually passed through scrubbers to remove flue dust. The scrubbers are usually of lead construction and Worthite pumps have been used successfully in circulating water over the scrubber. Subsequently the SO_3 gas is dried by passing through a tower over which a Worthite pump circulates concentrated sulphuric acid which becomes saturated with the

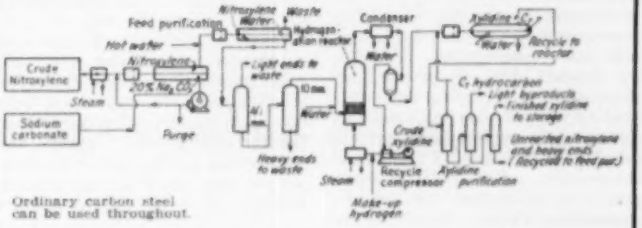
Sulphuric Acid



Tetrachlorethane



Xylidene



Ordinary carbon steel can be used throughout.

Key Materials of Construction

1. Aluminum	11. Impervious Graphite	21. Type 316
2. Brick	12. Iron	22. Type 317
3. Bronze	13. Lead	23. Type 347
4. Carbon Steel	14. Monel	24. Type 430
5. Cast Iron	15. Nickel	25. Stoneware
6. Chemical Lead	16. Rubber	26. Tile
7. Concrete	17. Silica	27. Tygon
8. Copper	18. Steel	28. Wood
9. Glass	19. Stainless Steel	
10. High Silicon Iron	20. Type 304	

a = alloys; l = linings (with steel backing in almost all cases); r = refractory lined; O materials used in combination; two numbers: either material may be used.

SO_3. No discernible corrosion or wear has been reported on such application of Worthite pumps.

In the handling of other corrosive solutions containing some SO_3 the rates of corrosion are generally in the order of what might be expected by the corrosive elements present other than SO_3. Such solutions are encountered in many processes involving the manufacture of adhesives (H_2SO_4 and H_2SO_3), some types of plating solutions, starch manufacturing, and fatty acids (Tall oil) involving small amounts of sulphuric and sulphurous acids at 300 deg. F. Worthite is giving excellent service in all of these fields

—W. E. Pratt

SULPHURIC ACID

ALUMINUM

Fairly resistant to dilute solutions and quite resistant to highly concentrated solutions. Used in connection with spin bath (solution containing sulphuric acid and sodium sulphate) as phenolic-coated spinning buckets and uncoated extrusions in hoods subject to spin bath spray.

Aluminum covers used over absorption towers where sulphur trioxide is bubbled through concentrated sulphuric acid to form fuming sulphuric acid. Laboratory tests indicate possible use of aluminum heat exchangers for highly concentrated sulphuric.

—Ellis D. Verink, Jr.

CARBON

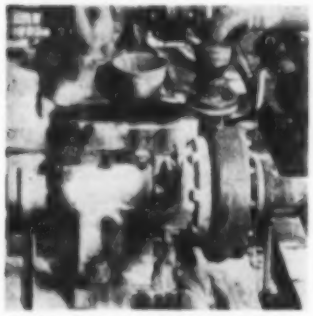
Carbon can be used for all solutions from 0 to 96 percent at any temperature. Use in vapor phase limited only by presence of sulphur trioxide at upper limits of temperature and concentration. Graphite less resistant above 60 percent, but often preferred for lower concentrations because of easy machinability. Carbon and graphite are inert in reducing conditions at all commercial temperatures, and in oxidizing atmospheres up to 60 and 800 deg. F., respectively. Karbate impervious carbon or graphite is suitable at all concentrations from 0 to 96 percent at temperatures up to 340 deg. F. In vapor phase, gas stream temperatures may be considerably higher if Karbate body is held to 340 deg. F. by cooling. Carbon, graphite and Karbate may be used with mixtures of sulphuric and other corrosives, unless the foreign material creates highly oxidizing conditions (for instance, a little nitric in concentrated sulphuric may cause oxidation of carbon materials through formation of highly oxidizing nitrosylsulphuric acid).

Carbon or graphite widely used for (or as lining for) concentrators, scrubbers, ducts, ejectors, barometric condensers, nozzles, stacks, electrostatic precipitators and other equipment handling sulphuric acid.

Karbate used most in heat exchangers of all types. For example: Heaters for vacuum concentrators. Boiling alcohol and ether out of sulphuric acid solution. Cool boiling 45 Be. acid in dilution unit. Rayon spin bath evaporators. Evaporating acid slurry of beryllium sulphate. Immersion heaters in plating and pickling tanks. Also, Karbate piping, valves, pumps and other accessories used widely in severe services with sulphuric and its mixtures.

—W. W. Palmquist

Materials at Work:



WORTHITE vs. SULPHURIC ACID
Worthite pump handles 87-90 percent black spent sulphuric in petroleum refinery.

CHLORIMETS

Recommended for severe conditions (high temperatures or in presence of corrosive contaminants). Curves plotted from laboratory tests at high temperatures show that as concentration increases, corrosion of Chlorimet 3 increases, while that of Chlorimet 2 falls off. At 176 deg. F. corrosion of the two alloys is about equal (8-10 mils per yr.) at a concentration of 35 percent. At boiling temperatures, they are about equal (10-11 mils per yr.) at a concentration of 10 percent.

Some successful applications in sulphuric acid services: Chlorimet 2 handling reactor dump composed of 28 percent sulphuric acid, 28 sodium sulphate, 3 sodium chloride, 30 water and a small amount of methanol at 240-250 deg. F. Chlorimet 3 handling scrubber solution, a mixture of sulphuric, hydrochloric, nitric and selenous acids and sodium chloride at 140-150 deg. F. Chlorimet 3 in long period tests in rayon spin bath at high temperatures showed negligible corrosion. Chlorimet 3 handling fatty acids sulphonated with dilute sulphuric acid at temperatures up to 175 deg. F. Chlorimets 2 and 3 both highly resistant to 56 Be. sulphuric saturated with chlorine.

In general, Chlorimet 2 is for reducing conditions, Chlorimet 3 for oxidizing.

—Walter A. Luce

COATINGS

Above 100 percent, sulphuric acid will destructively char all the currently used organic coatings. Thin film coatings should never be used for concentrations below 65 percent, as imperceptible discontinuities from application or use will permit rapid corrosion of base metal. At concentrations between 65 and 98 percent, thin films of phenolics and furans are used to prevent iron contamination of special iron-free grades of acid. Except for polyethylene and its halogenated derivatives, the thermoplastics and rubbers should not be used at concentrations over 60 percent—and polyethylene, its derivatives, and the thermosetting materials should not be used over 98 percent. Neither group should be used at these maximum acid concentrations at temperatures over atmospheric. Service life of any protective barrier will increase with decreasing concentration and temperature.

—Kenneth Tator

DURIMET 20

At 70 deg. F.: negligible corrosion at all concentrations.

At temperatures just under 176 deg. F.: acceptable corrosion rates at all concentrations.

At 176 deg. F.: satisfactory resistance up to 65 percent; between 65 and 93 percent, sulphuric is vicious on all stainless alloys and although numerous successful applications of Durimet 20 are on record, great care is urged.

Boiling temperatures: acceptable corrosion up to 10 percent.

Typical applications: Pumps, tank outlets, jets, valves, racks, skid bars,

dancer rolls and guide rolls in sulphuric acid pickling solutions of 6-10 percent acid at 180 deg. F. in batch picklers, and 25-30 percent acid up to but not over 220-230 deg. F. in continuous picklers. Also satisfactory (over 18 mo. service) handling sandy mixture of 34 percent sulphuric plus bauxite in manufacture of alum at a little over 200 deg. F. Durimet 20 pumps used to handle solution of 10-20 percent sulphuric plus 1-5 percent hydrofluoric acid at 120-140 deg. F. Excellent service handling tanning solution containing 4 percent sulphuric acid plus 19 percent sodium chloride at room temperature. Large quantities used to handle oleum at temperatures well over atmospheric. Great many other applications in varied sulphuric acid services in textile mills, rayon and cellophane plants, by-product coke works, electrolytic manganese plants and many diversified chemical plants. —Walter A. Luce

DURIRON

Excellent resistance to all concentrations of pure sulphuric acid at all temperatures up to and including boiling. Limitations are susceptibility to thermal and mechanical shock and to corrosion by fluorine, fluorides, sulphurous acid and a few other possible contaminants.

Applications: Pumps, piping, valves, tower outlets and various other equipment for chamber process, particularly where temperatures are too high for lead. Various services in fertilizer plants, including pumps and valves for 50 Be. acid at 250-300 deg. F. Sleeves, tubes and Y-valves on Mantius concentrators; pipe, fittings and tank outlets on Chemico concentrators; tubes and liners for falling-film concentrators; circulating pumps and valves around all three types of concentrators. Pumps and valves handling 34 percent sulphuric at over 200 deg. F. in alum manufacture. Wide use of pumps in paper mills handling alum solutions containing free sulphuric acid. Over five years service from pumps and valves handling highly corrosive slurry of sand, beryllium sulphate and sulphuric acid near boiling point. Heat exchangers, pipe and fittings used in cooling 70-77 percent sulphuric from 350 deg. F. to around 100 deg. F. Great many other services in all kinds of chemical and metallurgical operations.

—Walter A. Luce

GLASS LINING

Glass lined steel equipment is entirely satisfactory for sulphuric acid at all concentrations up to 450 deg. F. Rates of attack based on laboratory tests:

Conc., Wt. %	Mils Penetration per Yr. Room Temp.	Boiling, Reduced
2	0.004	—
5	0.020	0.583
10	0.007	—
20	0.017	1.478
40	0.015	0.141
60	0.010	—
80	0.014	None
95	0.014	—

Many large jacketed reactors in sulphonation service at 280-300 deg. F. Other open and closed units for mixing and other processes cover whole range of concentrations and temperatures. Particularly large use where complete lack of metal contamination is essential requirement, as in manufacture of dyestuffs and plastics.

—S. W. McCann

IRON & STEEL

Extensively used in sulphuric acid service for concentrations from about 80 percent up to 100 percent. With concentrations over 98 percent and temperatures up to 140 deg. F., steel is recommended for tanks and piping. For valves and pumps where velocities are high, chrome-nickel alloys are more satisfactory. In the range between 100 and 102 percent, neither cast iron nor steel is serviceable. Above 102 percent steel is satisfactory with the same exceptions as between 98 percent and 100 percent. Where the concentration is between 90 and 98 percent steel is recommended for tanks and cast iron for pumps and valves at temperatures up to the boiling point. Both steel and cast iron may be used for piping, although cast iron is preferred at the higher temperatures.

In the concentrations between 80 and 90 percent at atmospheric temperatures, cast iron and steel are both reasonably serviceable, although corrosion is greater in this range than it is for the higher concentrations. For values much below 80 percent, the use of iron and steel is not recommended as the corrosion rate is excessive.

—Albert W. Spitz

LEAD

Famous for its resistance to all but concentrated sulphuric acid. At room temperature resists all concentrations up to 96 percent. Resists 85 percent acid up to 425 deg. F. and sometimes satisfactory to 480 deg. F. High velocities or abrasion can increase corrosion by removing protective sulphate film. In one 14-day test, sulphate film was dissolved off of specimens once a day with these results:

Acid Conc., %	Mils Penetration per Yr. 122 Deg. F.	Boiling
30	<5	<5
50	<5	10
70	<5	90
90	20	>100
95	>100	—

Biggest use for lead is chamber process. Some old box chambers show virtually no corrosion after 30 or 50 yr. service. Lead or lead-lined ducts, scrubbers, coolers, pipe, valves, pumps, Cottrells, etc. widely used to handle roaster and sulphuric acid gases and solutions in byproduct acid plants. Other well known applications: lining in vacuum concentrators, lining and sometimes steam coils in pickling tanks, lining in alum boiling tanks. Ceramic or carbon brick inner linings should be used if temperatures approach lead's softening point, or fluctuate rapidly, or if abrasion exists.

—Kempton H. Roll

NICKEL & ALLOYS

Monel commonly used under essentially reducing conditions at moderate velocities. Corrosion considerably accelerated by aeration and by presence of chromates, nitrates and oxidizing salts like ferric, cupric or mercuric sulphates. In unaerated solutions Monel usually has suitable resistance up to 85 percent at atmospheric temperature; up to about 60 percent at 200 deg. F.; and up to about 15 percent at boiling. Monel equipment commonly used in sulphuric acid pickling of steel, splitting of fats and washing of organic materials. Also in sulphonation of oils, production of ammonium sulphate, and evaporation of non-oxidizing acid sulphates like zinc, stannous, magnesium, nickel and sodium sulphates.

Nickel and Inconel frequently can be used at low or moderate temperatures; usually less resistant than Monel. Corrosion increased by elevated temperatures and, except in cold concentrated acid, by aeration. Presence of oxidizing salts increases corrosion of nickel considerably; may passivate Inconel at room temperature but not at elevated. Nickel tubes commonly used in evaporation of viscose spin bath when held below 122 deg. F. by vacuum. Inconel used for baskets in pickling copper and brass at room temperature, and for handling acid dye baths.

Ni-Resist alloys useful for very dilute unaerated sulphuric acid or for non-oxidizing acid sulphates at low or moderate temperatures. Corrosion increased by increase in temperature, aeration or velocity. Somewhat similar to cast iron in resistance to concentrated acid. Type 3 (28-32 Ni)

can be used in fuming acid at high temperatures and is resistant to cracking which sometimes occurs with cast iron. —W. Z. FRIEND

RUBBER LINING

It is possible to handle concentrations—Up to 50 percent at room temperature with soft or semi-hard rubber. Up to 70 percent at 120 deg. F. with neoprene or special ebonite compounds. Up to 70 percent at 158 deg. F. with butyl. Up to 25 percent at 200 deg. F. with special ebonite compounds.

Within these limits, rubber linings have been applied successfully and extensively to—Pickling tanks, usually with an inner liner of brick or cement to protect against mechanical abuse. Evaporators and crystallizers recovering salts from sulphuric acid, and the distribution piping and storage tanks connected with such operations. Sulphuric acid mixing tanks, sufficient agitation being required to keep concentrated acid from settling to the rubber-covered bottom. Storage and process equipment handling ferro-sulphate solutions in the pigments industry. Centrifugals for separation of solids from sulphuric liquors. Fans, hoods and ducts for disposal of sulphuric acid fumes.

—O. S. TRUE

SILICONES

Five silicone fluids, three resins, and eight rubbers were laboratory tested against 10 percent, 30 percent and concentrated sulphuric acid at room temperature and at 100 deg. C. With three exceptions, all of the silicone materials showed exactly the same thing: good resistance to the 10 and 30 percent acid at both temperatures, and poor resistance to the concentrated acid at both temperatures. The three exceptions: One of the fluids was only fair where the other four were good. One of the resins (a laminating resin and tested as such in a glass cloth laminate) showed fair resistance to cold concentrated acid where the other two were poor. And among the rubber stocks, only two, Silastics 180 and 181, which are compounded to give maximum chemical resistance, showed the above described resistance; the other six were all poor.

Laboratory tests and field experience indicate that Dow Corning Valve Seal A is a serviceable lubricant in valves handling 10 and 30 percent sulphuric acid. Its successful use in valves handling 98 percent sulphuric acid at room temperature has been reported. —J. A. MCHARD

STAINLESS STEEL

Poor resistance to pure acid. Type 316 useful up to 5 percent at room temperature, Type 317 up to 5 percent at 150 deg. F. All the chrome-nickel stainless steels are safe for pure concentrated acid (66 Be.) at room temperature; none is suitable for fuming sulphuric.

Intermediate concentrations of pure acid are severely corrosive to stainless, but these concentrations with other materials present are often innocuous. For instance, pure 30 percent acid at 200 deg. F. corrodes Types 316 and 304 at 2-3 in. per month; laboratory tests show that addition of the following amounts of salts or acid reduce corrosion to negligible amounts:

	Type 304	Type 316
Copper sulphate	1%	1%
Chromic acid	2	1
Sodium dichromate	2	1
Sodium nitrate	20	0

Most of the sulphates have inhibiting effect and in sufficient quantity permit use of stainless. For instance attack on Type 316 is negligible in 10 percent, 150 deg. F. acid containing 15 percent ammonium sulphate.

Applications: Type 316 ammonium sulphate saturators. Type 304 tanks for certain chrome plating solutions. Type 304 pipe, conveyors and pumps for brass pickling solutions that have copper sulphate added. Type 316 tanks, heating coils and pipe in sulphonation of oils where the 66 Be. acid is not diluted. Type 316 (and under some conditions, Type 304) car tanks, storage tanks, nitration kettles, pipe, fittings and pumps handling mixed acid (sulphuric, nitric and water). —W. G. RENSHAW

STONEWARE

Resistant to all concentrations, subject only to normal limitations of temperature, pressure and fragility which govern any application of ceramic ware. Piping, valves and pumps commonly used for all concentrations, and particularly where concentration fluctuates over wide range, or where sulphuric is mixed with hydrochloric or nitric acid. Storage vessels, towers and reactors also used extensively.

Particular application handling sulphuric acid is in manufacture of hydrogen peroxide, where cells, towers and piping are stoneware.

—F. E. HERSTEIN

TANTALUM

Dilute sulphuric acid does not attack tantalum at any temperature at which tests have been made, nor is attack appreciable in concentrated acid at temperatures up to 340 deg. F. Tests are recommended before using at higher temperatures. Free SO_3 in fuming acid is destructive to tantalum even at room temperatures. Laboratory tests in concentrated and fuming acid gave these results:

	Corrosion Rate, Mils per Yr.
In Concentrated Acid	
66-79 deg. F.	0.00
297 deg. F.	0.0035
347 deg. F.	0.123
392 deg. F.	1.58
482 deg. F.	28.8
572 deg. F.	344
In Fuming Acid Containing 15 Percent SO_3	
73 deg. F.	0.277
158 deg. F.	92
208 deg. F.	3,950

Tantalum spinnerettes used more than 20 years in viscose rayon process. Tantalum heaters for sulphuric acid spin baths in operation for long periods with no reported failures. Tantalum heater used to boil mixture of sulphuric acid, sodium chloride and methanol. Bayonet heaters in use more than four years in Mantius concentrators (their higher heating efficiencies have materially increased capacity of concentrators).

—LEONARD R. SCRIBNER

WORTHITE

One of the most widely used alloys for pumps and valves. At 70 deg. F., corrosion rates are less than 1 mil per yr. for all concentrations from 0 to 110 percent. At 176 deg. F. (in a test designed to simulate conditions in a pump, the specimens being whirled at a linear velocity of 5 ft. per sec.), corrosion rates were measured at less than 1 mil per yr. at concentrations up to 45 percent, 2 mils at 50 percent, several hundred mils between 55 and 85 percent, back down to 30 mils at 90 and 10 mils at 100 percent. Top temperature in the critical range between 50 and 90 percent is about 140 deg. F., although 150 deg. F. has been reported as not too severe. These rates were obtained in commercially pure acid; they would be much higher if halides (sodium chloride, for instance) were present, and much lower in the presence of highly oxidizing materials like nitric acid or copper sulphate. Addition of 5 percent or more nitric acid to 70 percent sulphuric at 176 deg. F. cuts corrosion from 400-500 mils per yr. to a very low amount. Under certain limited and rather uncommon conditions (handling medium strengths of hot, de-aerated acid), Worthite pumps or valves in a large lead system of pipes and tanks may become anodic to the lead and suffer galvanic corrosion unless insulated from the lead.

—W. E. PRATT

Directory of Materials

For the 14th time we have polled the manufacturers of corrosion resistant materials of construction. As always they have responded nobly; it has taken 12 pages to list all the metals, carbonaceous materials, cements, ceramics, refractories, rubber products and plastics available to the corrosion engineer. Warning: The applications listed are intended to suggest, in a general way only, the field of greatest usefulness for the several materials. There is no implication, where, say, sulphuric acid is listed, that the material in question will withstand any temperature or concentration of the acid. Such limitations exist in every case; they have been omitted here because the intent has been general suggestion, not precise definition, of corrosion resistance.

METALS & ALLOYS

Materials	Manufacturer	Description	Most Important Applications
Acipco Stainless	Amer. Cast Iron Pipe Co., Birmingham, Ala.	Various standard stainless steels.	
Admiralty	Generally available.*	70 Cu; 1 Sn; 29 Zn.	Fresh and salt waters.
Admiralty, Antimonial	Chase Brass & Copper Co., Waterbury, Conn.	71 Cu; 27 965 Zn; 1 Sn; 0 035 Sb.	Petroleum compounds, corrosive waters, salt brines.
Admiralty, Arsenical	Generally available.*	71 Cu; 28 Zn; 1 Sn; 0 04 As, Sb or P.	Fresh and salt water, distillery liquors, petrol. prods.
Admiralty, Phosphorized	Scovill Mfg. Co., Waterbury, Conn.	71 Cu; 28 Zn; 1 Sn; 0 03 P.	Corrosive atmospheres, hot and cold fresh water, salt water, weak alkalis, weak mineral acids.
Advance	Driver Harris Co., Harrison, N. J.	55 Cu 45 Ni	
Aluminum, 99 0% Al	Aluminum Co. of Amer., Pittsburgh, Pa.	99 8 Al.	Foods, hydrogen peroxide, nitric acid, fermentation chemicals, beer and bev. essential oils.
Aluminum, 2S	Generally available.†	99 2 Al min	Alcohol, naval stores, syn. resins and fibers, aldehydes, explosives.
Aluminum, 3S	Generally available.†	Al; 1 2 Mn.	Atmosphere, foods, short chain aliphatics and their anhydrides, nitric and fatty acids, ammonium nitrate, esters.
Aluminum, 4S	Generally available.†	Al; 1 2 Mn; 1 Mg.	Atmosphere.
Aluminum, Clad 2S	Generally available.†	2S clad with 72S (Al; 1 Zn).	Water, naval stores, sulphur and hydrogen sulphide.
Aluminum, Clad 4S	Generally available.†	4S clad with 72S (Al, 1 Zn).	Atmosphere, water, sulphur and hydrogen sulphide.
Aluminum, 50S	Reynolds Metals Co., Louisville, Ky.	Al; 1 3 Mg	Foods, alcohols, esters, petroleum products, synthetic fibers.
Aluminum, 52S	Generally available.†	Al; 2 5 Mg; 0 25 Cr.	Atmosphere, foods, alcohols, naval stores, syn. resins and fibers.
Aluminum, 61S	Generally available.†	Al; 0 25 Cu; 0 6 Si, 0 25 Cr.	Atmosphere, alcohols, ammonium nitrate, petroleum products, refrigerants, sulphur and hydrogen sulphide.
Aluminum, 74S	Kaiser Aluminum & Chemical Corp., Chicago, Ill.	Al; 4 5 Cu; 1 5 Mg; 0 6 Mn (also available in clad form where additional corrosion protection is required).	Atmosphere.
Aluminum, 63S	Generally available.†	Al; 0 4 Si; 0 7 Mg.	Atmosphere, water, short chain aliphatics and their anhydrides, fatty acids, petroleum products.
Aluminum, Clad 53S	Aluminum Co. of Amer., Pittsburgh, Pa.	53S (Al; 0 7 Si, 1 3 Mg; 0 25 Cr) clad with high purity Al.	Synthetic resins, esters, aldehydes, beer and bev., soaps and cosmetics, essential oils.
Aluminum, 4S	Generally available.†	Al; 5 Si	Atmosphere, water, short chain aliphatics and their anhydrides, fatty acids, naval stores, soaps.
Aluminum, 145S	Kaiser Aluminum & Chemical Corp., Chicago, Ill.	Al; 1 3 Mg (also available in clad form where additional corrosion protection is required).	Foods, alcohols, esters, petroleum products, syn. fibers.
Aluminum, 214	Generally available.†	Al; 3 5 Mg.	Foods, alcohols, esters, petroleum products, syn. fibers.
Aluminum, B214	Generally available.†	Al; 3 5 Mg; 1 5 Si.	Atmosphere, water, foods, ammonium nitrate, syn. resins, beer and bev.
Aluminum, 356	Generally available.†	Al; 7 Si; 0 3 Mg.	Hydrogen peroxide, short chain aliphatics and their anhydrides, nitric acid, aldehydes, rubber, refrigerants.
Allegheny Metal	Allegheny Ludlum Steel Corp., Brackenridge, Pa	Various standard stainless steels.	
Alloyco N-2 (Hastelloy "B")	Alloy Steel Products Co., Linden, N. J.	60 Ni; 26 0-30 0 Mo; 1 00 max. Mn; 1.00 max. Si; .07 max. C; 5 0-6 0 Fe; 0 25-0 50 V.	All conc. quiescent aluminum chloride, hydrochloric acid, 45% and 60% phosphoric acid (C. P.) at boiling, 30 to 95% phosphoric acid (technical), zinc chloride.
Alloyco N-3 (Hastelloy "C")	Alloy Steel Products Co., Linden, N. J.	Ni; 16-17 Cr; 16-18 Mo; 3 75-5.25 W; 4.5-7.0 Fe; 0.1 C max.; 0.2-0 4 V; 1 max. Mn; 1 max. Si.	Bromine (wet), chlorine gas (saturated vapor).
Alloyco-20	Alloy Steel Products Co., Linden, N. J.	Fe; 19-21 Cr; 28-30 Ni; 4 0-4 5 Cu; 2.5-3 0 Mo; 1 5 max. Si; 0 65-0 85 Mn; 0 07 max. C.	Acetic acid, 25% nitric acid, 75% sulphuric acid at boiling, 5% nitric acid, 20% sulphuric acid at boiling, 10% sulphuric acid and 2% ferric sulphate at boiling, ammonium sulphate, conc. citric acid, 10% sodium sulphite, all concentrations of sulphuric acid, conc. lactic acid.

NOTE: Many of the names listed here in the "Materials" column are trademarks and are not to be understood by presentation here to denote generic or descriptive names for general use.

* "Generally available" copper alloys may be obtained from such companies as the following: American Brass Co., Waterbury, Conn.; American Metal Co., New York, N. Y.; Ampco Metal Inc., Milwaukee, Wis.; Bridgeport Brass Co., Bridgeport, Conn.; Bristol Brass Co., Bristol, Conn.; Chase Brass & Copper Co., Waterbury, Conn.; Mueller Brass Co., Port Huron, Mich.; New England Brass Co., Taunton, Mass.; Phelps Dodge Copper Products Corp., New York, N. Y.; Revere Copper & Brass, Inc., New York, N. Y.; Riverside Metal Co., Riverside, N. J.; Scovill Mfg. Co., Waterbury, Conn.; Seymour Mfg. Co., Seymour, Conn.; Wolverine Tube Co., Detroit, Mich.

† "Generally available" aluminum and aluminum alloys can be obtained from Aluminum Co. of America, Pittsburgh, Pa.; Reynolds Metals Co., Louisville, Ky.; Kaiser Aluminum & Chemical Corp., Chicago, Ill.

Materials	Manufacturer	Description	Most Important Applications
Alloyco 55	Alloy Steel Products Co., Linden, N. J.	24-26 Cr; 19-21 Ni; 2.75-3.25 Mo; 0.80-0.75 Mn; 0.75-1.00 Si; 0.07 C max.; bal. Fe.	
Alloyco 304 (18-8)	Alloy Steel Products Co., Linden, N. J.	18-20 Cr; 9-11 Ni; 0.80-0.75 Mn; 0.75-1.00 Si; 0.07 C max.; bal. Fe.	Acetic acid, 80% nitric acid, 50% sulphuric acid, fuming nitric acid, 10% potassium nitrate, ethyl alcohol.
Alloyco 316 (18-8MO)	Alloy Steel Products Co., Linden, N. J.	18-20 Cr; 9-11 Ni; 2.25-2.75 Mo; 0.80-0.75 Mn; 0.75-1.00 Si; 0.07 C max.; bal. Fe.	Acetic acid, acetic anhydride, aluminum sulphate, formic acid, lactic acid, zinc chloride.
Alumel	Hoskins Mfg. Co., Detroit, Mich.	94 Ni; 4 Al; 1 Si; 1 Mn.	
Ambraloy 901	Amer. Brass Co., Waterbury, Conn.	93 Cu; 9 Al.	
Ambraloy 917	Amer. Brass Co., Waterbury, Conn.	82 Cu; 9½ Al; 5 Si; 2½ Fe; 1 Mn.	
Ambraloy 927	Amer. Brass Co., Waterbury, Conn.	76 Cu; 21.96 Zn; 2 Al; .04 As.	
American Stainless	Amer. Steel Foundries, Newark, N. J.	Various standard stainless steels.	
A Metal	Midvale Co., Philadelphia, Pa.	Fe; 19 Cr; 35 Ni; 0.35 C; 1 Si; 0.5 Mn.	
AMF	Midvale Co., Philadelphia, Pa.	Fe; 46-50 Ni; 0.1-0.2 C; 1-2 Mn.	
Ampco 8	Ampco Metal, Inc., Milwaukee, Wis.	Cu; 7.5 Al; 2-2.5 Fe.	
Ampco 12	Ampco Metal, Inc., Milwaukee, Wis.	Cu; 8.5-9.3 Al; 2.5-3.25 Fe.	
Ampco 15	Ampco Metal, Inc., Milwaukee, Wis.	Cu; 9-10 Al; 2.75-3.75 Fe.	
Ampco 16	Ampco Metal, Inc., Milwaukee, Wis.	Cu; 9.5-10.3 Al; 3-4 Fe.	
Ampco 18	Ampco Metal, Inc., Milwaukee, Wis.	Cu; 10.3-11 Al; 3.0-4.25 Fe.	
Ampcoloy 40	Ampco Metal, Inc., Milwaukee, Wis.	Cu; 9.5-10.5 Al; 0.20 max. Fe.	
Ampcoloy 45	Ampco Metal, Inc., Milwaukee, Wis.	Cu; 9.7-10.9 Al; 2.0-3.5 Fe; 4.5-5.5 Ni; 1.5 max. Mn.	Sulphuric, acetic, citric acids; sodium chloride; alcohols; hydrocarbons.
Ampcoloy 62	Ampco Metal, Inc., Milwaukee, Wis.	55-60 Cu; 0.5-1.5 Al; 0.4-2.0 Fe; 1.5 max. Mn; 1.0 max. Sn; 0.4 max. Pb; 0.5 max. Ni; bal. Zn.	
Ampcoloy 66	Ampco Metal, Inc., Milwaukee, Wis.	60-65 Cu; 5-7 Al; 2-4 Fe; 2.5-5 Mn; 0.5 max. Sn; 0.2 max. Pb; 0.5 max. Ni; bal. Zn.	
Ampcoloy A2	Ampco Metal, Inc., Milwaukee, Wis.	Cu; 9-10 Al; 1.25 max. Fe.	
Ampcoloy E170	Ampco Metal, Inc., Milwaukee, Wis.	Cu; 9.5-11 Al; 1.5 max. Fe.	
Anhecinc	Worthington Pump & Machinery Corp., Harrison, N. J.	Fe; 14.5 Si.	Sulphuric acid slurries (under reducing conditions); hydrochloric, sulphuric acids; acid chlorides; stray current conditions.
Armco	Armco Steel Corp., Middletown, Ohio	Various standard stainless steels.	
Asarco Acid Lead	Amer. Smelting & Ref. Co., New York, N. Y.	Pb; 0.06 Cu; 0.025 Bi; 0.002 Ag; 0.001 Zn; 0.002 Fe.	Sulphuric, sulphurous, phosphoric, chromic, hydrofluoric acids.
Beryloy 10	Beryllium Corp., Reading, Pa.	Cu; 0.45-0.60 Be; 2.35-2.60 Co.	Corrosive atmospheres, fresh and salt waters, weak alkalis and mineral acids.
Beryloy 25	Beryllium Corp., Reading, Pa.	Cu; 1.80-1.95 Be; 0.20-0.35 Co.	Corrosive atmospheres, fresh and salt water; weak alkalis and mineral acids.
Beryloy 50	Beryllium Corp., Reading, Pa.	Cu; 0.25-0.50 Be; 1.40-1.70 Co; 0.90-1.10 Ag.	Corrosive atmospheres, fresh and salt waters, weak alkalis and mineral acids.
Beryloy 165	Beryllium Corp., Reading, Pa.	Cu; 1.60-1.80 Be; 0.20-0.35 Co.	Corrosive atmospheres, fresh and salt waters, weak alkalis and mineral acids.
Beryloy 10C	Beryllium Corp., Reading, Pa.	Cu; 0.55-0.70 Be; 2.35-2.60 Co.	Corrosive atmospheres, fresh and salt waters, weak alkalis and mineral acids.
Beryloy 20C	Beryllium Corp., Reading, Pa.	Cu; 2.00-2.20 Be; 0.35-0.60 Co.	Corrosive atmospheres, fresh and salt waters, weak alkalis and mineral acids.
Beryloy 275C	Beryllium Corp., Reading, Pa.	Cu; 2.60-2.85 Be; 0.35-0.60 Co.	Corrosive atmospheres, fresh and salt waters, weak alkalis and mineral acids.
Brass, Aluminum	Generally available.*	78 Cu; 22 Zn; 2 Al.	Sea and harbor waters, distillery liquors, petrol. prods.
Brass, Antimonial Aluminum	Chase Brass & Copper Co., Waterbury, Conn.	76 Cu; 21.95 Zn; 2 Al; 0.05 Sb.	Sea and harbor waters in condensers.
Brass, Cartridge	Generally available.*	70 Cu; 30 Zn.	Corrosive atmospheres, salt water, weak alkalis.
Brass, Forging	Scovill Mfg. Co., Waterbury, Conn.	60 Cu; 2 Pb; bal. Zn.	Corrosive atmospheres, salt water, weak alkalis.
Brass, Free Cutting	Scovill Mfg. Co., Waterbury, Conn.	61.5 Cu; 3 Pb; bal. Zn.	Corrosive atmospheres, salt water, weak alkalis.
Brass, High	Generally available.*	66 Cu; 34 Zn.	
Brass, Low	Generally available.*	80 Cu; 20 Zn.	
Brass, Low Leaded	Scoville Mfg. Co., Waterbury, Conn.	67 Cu, 0.5 Pb; bal. Zn.	Corrosive atmospheres, hot and cold fresh water, salt water, organic acids, weak alkalis.
Brass, Med. Leaded	Scoville Mfg. Co., Waterbury, Conn.	64.5 Cu; 1.0 Pb; bal. Zn.	Corrosive atmospheres, salt water, weak alkalis.
Brass, Naval	Generally available.*	60 Cu; 39.25 Zn; 0.75 Sn.	Corrosive atmospheres, salt water, weak alkalis.
Brass, Naval, Leaded	Scovill Mfg. Co., Waterbury, Conn.	60 Cu; 0.75 Sn; 1.75 Pb; bal. Zn.	Corrosive atmospheres, hot and cold fresh water, salt water, weak alkalis and mineral acids.
Brass, Red	Generally available.*	85 Cu; 15 Zn.	Corrosive atmospheres, hot and cold fresh water, salt water, weak alkalis and mineral acids.
Brass, Tin	Scovill Mfg. Co., Waterbury, Conn.	92 Cu; 1 Sn; 7 zn.	Acid sludge lines in oil refineries, salt and fresh water, non-oxidizing acids.
Bronze, Aluminum	Generally available.*	82-95 Cu; 5-10 Al; Fe; Mn; Ni; Sn.	Corrosive atmospheres, hot and cold fresh water, salt water, weak alkalis, organic and weak mineral acids.
Bronze, Aluminum Silicon	Bridgeport Brass Co., Bridgeport, Conn.	91 Cu; 7 Al; 2 Si.	Sulphuric, acetic, citric acids; sodium chloride; hydrocarbons; distillery liquors; fresh and salt water.
Bronze, Commercial	Generally available.*	90 Cu; 10 Zn.	Water, non-oxidizing acids, atmosphere.
Bronze, Commercial, Leaded	Scovill Mfg. Co., Waterbury, Conn.	80 Cu; 1.75 Pb; 9.25 Zn.	Corrosive atmospheres, hot and cold fresh water, salt water, weak alkalis, organic and weak mineral acids.
Bronze, 600 Forgeable Bearing	Mueller Brass Co., Port Huron, Mich.	58 Cu; 37 Zn; 5 Hardener.	Corrosive atmospheres, hot and cold fresh water, salt water, weak alkalis, organic and weak mineral acids.
Bronze, Gilding 95%	Scovill Mfg. Co., Waterbury, Conn.	95 Cu; 5 Zn.	
Bronze, 603 Forgeable Bearing	Mueller Brass Co., Port Huron, Mich.	58 Cu; 36 Zn; 1 Pb; 5 Hardener.	Corrosive atmospheres, hot and cold fresh water, salt water, weak alkalis, organic and weak mineral acids.
Bronze, Hardware	Scoville Mfg. Co., Waterbury, Conn.	89 Cu; 9 Zn; 2 Pb; 1 Ni.	

Bronze, High Leaded Tin	Mueller Brass Co., Port Huron, Mich.	58 Cu; 36 Zn; 1 Pb; 5 Hardener	
Bronze, Manganese	Mueller Brass Co., Port Huron, Mich.	65 3 Cu; 3 Fe; 4 5 Al; 3 7 Mn; Zn.	
Bronze, High Strength Manganese	Mueller Brass Co., Port Huron, Mich.		
Bronze, Phosphor, 5%	Generally available.*	95 Cu; 5 Sn; P.	
Bronze, Silicon, High	Bridgeport Brass Co., Bridgeport, Conn.	97 Cu; 3 Si.	
Bronze, Silicon, Low	Bridgeport Brass Co., Bridgeport, Conn.	98 2 Cu; 1 8 Si.	
Bronze, Spring	Scovill Mfg. Co., Waterbury, Conn.	86 5 Cu; 2 Sn; 11 5 Zn.	
Bronze, Tobin	Generally available.*	60 Cu; 39 25 Zn; 0 75 Sn	
Buffokast Gray Iron	Buffovak Equipment Div., Blaw-Knox Co.	Fe; 3-4 C; 2 max. Ni; 1-2 Si; 0 5-1 25 Mn; 0 12 max. S, 0 3 max. P.	
CA Stainless	Copper Alloy Fdry. Co., Hillside, N. J.	Various standard stainless steels.	
Calite A	Calorizing Co., Wilkinsburg, Pa.	Fe; 35 Ni; 15 Cr.	
Calite B2S	Calorizing Co., Wilkinsburg, Pa.	Fe; 25 Cr; 10 Ni; 1 Mo.	
G. O. Carbon Stainless	G. O. Carbon, Inc., Thorndale, Pa.	Various standard stainless steels.	
Carpenter Stainless	Carpenter Steel Co., Reading, Pa.	Various standard stainless steels.	
Carpenter Stainless 20	Carpenter Steel Co., Reading, Pa.	Fe; 29 Ni; 20 Cr; 3 Cu; 2 Mo; 0 07 max. C.	
Causal Metal	Lunkenheimer Co., Cincinnati, Ohio	Fe; 19 Ni; 2 2-2 8 C; 4 Cu; 1 5 Cr	
Chemalloy Stainless	Electro-Alloys Div., Amer. Brake Shoe Co., Elyria, Ohio.	Various standard stainless steels.	
Chemalloy A52N	Electro-Alloys Div., Amer. Brake Shoe Co., Elyria, Ohio.	Fe; 21 Cr; 27 Ni; 2 Mo; 3 Cu; 2 Si.	
Chemalloy H1	Electro-Alloys Div., Amer. Brake Shoe Co., Elyria, Ohio.	Ni; 21 Mo; 21 Fe.	
Chemalloy H2	Electro-Alloys Div., Amer. Brake Shoe Co., Elyria, Ohio.	Ni; 29 Mo; 6 Fe.	
Chemalloy H3	Electro-Alloys Div., Amer. Brake Shoe Co., Elyria, Ohio.	Ni; 14 Cr; 16 Mo; 4 W; 6 Fe.	
Chemalloy H4	Electro-Alloys Div., Amer. Brake Shoe Co., Elyria, Ohio.	Ni; 10 Si; 3 Cu.	
Chlorinet 2	Duriron Co., Dayton, Ohio.	63 Ni; 32 Mo; 2 Fe; 0 10 C; 1 Si.	
Chlorinet 3	Duriron Co., Dayton, Ohio.	60 Ni; 18 Mo; 18 Cr; 3 Fe; 0 07 max. C; 1 Si.	
Chromax	Driver Harris Co., Harrison, N. J.	Fe; 19 Cr; 35 Ni.	
Chromel A	Hoskins Mfg. Co., Detroit, Mich.	80 Ni; 20 Cr.	
Chromel C and D	Hoskins Mfg. Co., Detroit, Mich.	35-61 Ni; 16-18½ Cr; 25-46½ Fe.	
Chromel P	Hoskins Mfg. Co., Detroit, Mich.	90 Ni; 10 Cr.	
Circle L Stainless	Lebanon Steel Fdry., Lebanon, Pa.	Various standard stainless steels.	
Colonial 610	Vanadium Alloys Steel Co., Latrobe, Pa.	Fe; 16-18 Cr; 1 Ni; 0 12 max. C; S (optional).	
Cooper Stainless	Cooper Alloy Foundry Co., Hillside, N. J.	Various standard stainless steels.	
Cooper FA20	Cooper Alloy Foundry Co., Hillside, N. J.	0 07 max. C; 20 Cr; 29 Ni; 1 Si; 3 5 Mo; 4 Cu.	
Copel	Hoskins Mfg. Co., Detroit, Mich.	55 Cu; 45 Ni.	
Copper	Generally available.*	99 9 + Cu.	
Copper, Beryllium	Generally available.*	97 5 Cu; 2 13 Be; 0 35 Ni.	
Copper, Cadmium	Phelps Dodge Copper Prod. Corp., New York, N. Y.	99 Cu; 1 Cd.	
Copper, Deoxidized	Generally available.*	99 9 + Cu; 0 01-0 03 P.	
Copper, Phosphorized	Mueller Brass Co., Port Huron, Mich.	99 9 Cu; trace P.	
Corrosloy	Pacific Fdry. Co., Ltd., San Francisco, Calif.	Fe; 14 5 Si.	
Croloy Intermediate	Babcock & Wilcox Tube Co., Beaver Falls, Pa.	Fe; à 7 or 9 Cr; 0 5 or 1 Mo.	
Croloy Stainless	Babcock & Wilcox Tube Co., Beaver Falls, Pa.	Various standard stainless steels.	
Croloy Clad Plate	Babcock & Wilcox Co., New York, N. Y.	Steel clad with various standard stainless steels.	
Crucible Stainless	Crucible Steel Co. of Amer., New York, N. Y.	Various standard stainless steels.	
Cupaloy	Westinghouse Electric Corp., Pittsburgh, Pa.	99 4 Cu; 0 1 Ag; 0 5 Cr.	
Cupron	Wilbur B Driver Co., Newark, N. J.	Cu; 45 Ni.	
Cupro-Nickel, 15, 20, 30%	Generally available.*	Cu; 15, 20 or 30 Ni.	
Cupro-Nickel, 30%	Chase Brass & Copper Co., Waterbury, Conn.	68 8 Cu; 30 Ni; 0 45 Fe; 0 75 Mn.	
Cupro-Nickel, 90-10	Bridgeport Brass Co., Bridgeport, Conn.	90 Cu; 10 Ni; Fe.	
Cupro-Nickel, 80-20	Bridgeport Brass Co., Bridgeport, Conn.	80 Cu; 20 Ni; Fe.	
Dimaloy	Westinghouse Electric Corp., Pittsburgh, Pa.	25 Ni; 13 Cr; 3 Mo; 1 6 Ti; bal. Fe.	
Disston Stainless	Henry Disston & Sons Inc., Philadelphia, Pa.	Various standard stainless steels.	
Dopploy 20	Sowers Mfg. Co., Buffalo, N. Y.	Fe; 18 5 Ni; 2 35 Cr; 2 85 C; 1 Mn.	
Dow metal	Dow Chemical Co., Midland, Mich.	Various magnesium alloys.	
Duraloy Stainless	Duraloy Co., Scottdale, Pa.	Various standard stainless steels.	
Duriron Stainless	Duriron Co., Dayton, Ohio	Various standard stainless steels.	
Duriron D-10	Duriron Co., Dayton, Ohio.	65 Ni; 23 Cr; 3 5 Cu; 2 Mo; 1 Mn; 5 Fe.	
Durichlor	Duriron Co., Dayton, Ohio.	Fe; 0 85 C; 14 5 Si; 3 Mo; 0 65 Mn.	
Durimet 20	Duriron Co., Dayton, Ohio	Fe, 20 Cr; 29 Ni; 0 07 max. C; 2 Mo; 4 Cu; 1 Si.	
Duriron	Duriron Co., Dayton, Ohio	Fe; 0 85 C; 14 5 Si; 0 65 Mn.	
Eastern Stainless	Eastern Stainless Steel Corp., Baltimore, Md.	Various standard stainless steels.	
Enduro Stainless	Republic Steel Corp., Cleveland, Ohio.	Various standard stainless steels.	
Everdur 1030	Amer. Brass Co., Waterbury, Conn.	94 9 Cu; 4 Si; 1 1 Mn.	

Corrosive atmospheres, hot and cold fresh water, salt water, weak alkalis. Fourdrinier wire, organic and weak mineral acids.	
Water, non-oxidizing acids, refrigerants, atmosphere.	
Water, non-oxidizing acids, refrigerants, atmosphere.	
Corrosive atmospheres, hot and cold fresh water, salt water, weak alkalis, organic and weak mineral acids.	
Salt water, atmosphere.	
Caustic soda, caustic potash, dyes, waste materials, sulphite liquors, sour buttermilk.	
Sulphuric, mixed, phosphoric, oxalic, fatty acids.	
Sulphuric acid, sodium hydroxide; brine; paper liquors (sulphate and soda processes).	
Non-oxidizing media.	
Halogen ion services.	
Hydrochloric, phosphoric, sulphuric acids.	
Strong oxidizing agents; sulphurous, acetic, formic acids.	
Sulphuric acid.	
Hydrochloric, sulphuric, phosphoric acids, non-oxidizing chlorides.	
Hydrochloric, sulphuric, phosphoric chloroacetic acids; moist chlorine.	
Cyanide pots; neutral and alkaline salts; mild hydrochloric, sulphuric, organic acids.	
Sulphuric, hydrochloric, phosphoric acids; oxidizing chloride salts.	
Fresh and salt water, refrigerants (except ammonia), paper mill stock and white water, oil, brewery and distillery products.	
Water, distillery, brewery and paper mill liquors, steam, refrigerants, gasoline, oil, salts, acetic acid.	
Nitric, sulphuric, chromic, hydrochloric acids, mine water; ferrous and copper sulphate.	
Petrol. ref. (sulphur compounds).	
Oxidation resistance at high temperatures.	
Sea and harbor waters, salt brines, non-oxidizing acids, petrol. prods., caustics.	
Sea and harbor waters, salt brines.	
Sea water, fresh water, salt solutions, non-oxidizing acids, atmosphere.	
Boiler feed water, fresh water, atmosphere, sea water, salt solutions, non-oxidizing acids, petroleum products, caustic solutions.	
Oxidization resistance at high temperature.	
Hydrofluoric acid, strong caustic and alkalis, chromic acid.	
Sulphuric, phosphoric acids.	
Hydrochloric acid, hypochlorite bleaches, chloride solutions, moist chlorine.	
Sulphuric, nitric, acetic, sulphurous acids; fatty acids; plating solutions.	
Sulphuric, nitric, acetic acids; alum solutions; plating solutions.	

Materials	Manufacturer	Description	Most Important Applications
Everdur 1010	Amer. Brass Co., Waterbury, Conn.	95.8 Cu; 3.1 Si; 1.1 Mn.	
Everdur 1015	Amer. Brass Co., Waterbury, Conn.	98.25 Cu; 1.5 Si; 0.25 Mn.	
Fahrite Stainless	Ohio Steel Fdry. Co., Springfield, Ohio.	Various standard stainless steels.	
Fuseweld	Fusweld Metallurgical Corp., North Chicago, Ill.	Hard facing rod; W, Cr, Co, TaC, ClsC.	Nitric, sulphuric, acetic, lactic acids; salt water brine; hydrogen sulphide.
Frontier 5	Frontier Bronze Corp., Niagara Falls, N. Y.	60 Cu; 10 Al; 1 Fe.	Organic acid stills.
Frontier 11	Frontier Bronze Corp., Niagara Falls, N. Y.	84 Cu; 8 Ni; 5 Sn; 2 Zn.	
Frontier 40E	Frontier Bronze Corp., Niagara Falls, N. Y.	5.8 Zn; 0.5 Mg; 0.8 Cr; 0.2 Ti.	Salt water.
Gold	Baker & Co. Inc., Newark, N. J.	99.99 Au.	Nitric, hydrochloric, sulphuric, hydrofluoric acids.
Gold	American Platinum Works, Newark, N. J.		
Gun Metal	Mueller Brass Co., Port Huron, Mich.		
Hastelloy A	Haynes Stellite Co., Kokomo, Ind.	Ni; 20-22 Mo; 18-20 Fe.	Hydrochloric, sulphuric, acetic, formic acids; all alkalis.
Hastelloy B	Haynes Stellite Co., Kokomo, Ind.	Ni; 26-30 Mo; 4-7 Fe.	Hydrochloric, sulphuric, phosphoric, nitric, acetic, formic acids.
Hastelloy C	Haynes Stellite Co., Kokomo, Ind.	Ni; 16-18 Mo; 4-7 Fe; 14-16 Cr; 3.75-5 W	Strong oxidizing agents; free chlorine; phosphoric, nitric, sulphuric acids.
Hastelloy D	Haynes Stellite Co., Kokomo, Ind.	Ni; 8-11 Si; 3-5 Cu.	Sulphuric, acetic, formic, phosphoric acids.
Haynes Stellite 1	Haynes Stellite Co., Kokomo, Ind.	Co; 30-32 Cr; 12-14 W.	Chlorine; sulphuric, nitric acids.
Haynes Stellite 6	Haynes Stellite Co., Kokomo, Ind.	Co; 27-29 Cr; 3.75-4.5 W.	Sulphuric, nitric acids.
Haynes Stellite 12	Haynes Stellite Co., Kokomo, Ind.	Co; 28-30 Cr; 7.5-9 W.	Sulphuric, nitric acids.
Haynes Stellite 98M2	Haynes Stellite Co., Kokomo, Ind.	Co; 30-31 Cr; 18.55-18.95 W; 3.5-3.75 Ni.	Sulphuric acid.
Haynes Stellite Star J	Haynes Stellite Co., Kokomo, Ind.	Co; 32-32.75 Cr; 17.25-17.75 W.	Sulphuric acid.
Herculoy	Revere Copper and Brass, New York, N. Y.	96-98 Cu; 1.5-3.5 Si; 0.25-1 Mn.	Atmosphere, fresh and salt water, brewery and distillery products.
Hytensl	Amer. Manganese Bronze Co., Philadelphia, Pa.	60-68 Cu; 20-24 Zn; 3-7 Al; 2.5-5 Mn; 2-4 Fe.	
Illium G	The Illium Corp., Freeport, Ill.	56 Ni; 22.5 Cr; 6.5 Mo; 6.5 Fe; 6.5 Cu; Mn; Si; C	Sulphuric, nitric, phosphoric, mixed acids; various acid-salt solutions.
Illium R (wrought)	The Illium Corp., Freeport, Ill.	64 Ni; 22 Cr; 5 Mo; 2.5 Fe; 6 Cu; Mn; Si; C.	Sulphuric, nitric, phosphoric, mixed acids; various acid-salt solutions.
Inconel	International Nickel Co., New York, N. Y.	76 Ni; 15.5 Cr; 7.5 Fe; 0.08 C.	Organic acids, pharmaceuticals, alcoholic beverages, food, alkali fusion.
Inconel-Clad Steel	Lukens Steel Co., Coatesville, Pa.		Carbonic, lactic, picric acids; coca syrup; penicillin; wine.
Indium Metal	Amer. Smelting and Ref. Co., New York, N. Y.	In.	
Ingersoll Stainless	Ingersoll Steel Div., Borg-Warner Corp., Chicago, Ill.	Various standard stainless steels.	
Inoxet 20	Empire Steel Castings, Inc., Reading, Pa.	Fe; 20 Cr; 29 Ni; 0.07 max. C; 3.5 min. Cu; 1.75 Mo; 1 min. Si.	
Inoxet Stainless	Empire Steel Castings, Inc., Reading, Pa.	Various standard stainless steels.	
Jessop Stainless and Stainless-Clad	Jessop Steel Co., Washington, Pa.	Various standard stainless steels.	
K42B	Westinghouse Electric Corp., Pittsburgh, Pa.	42 Ni; 22 Co; 18 Cr; 15.9 Fe; 2.1 Ti	Oxidation resistance at high temperatures.
Kanthal Alloys	C. O. Jelliff Mfg. Corp., Southport, Conn.	Fe; 20-25 Cr; Co; Al.	
Lead	Eagle-Picher Co., Cincinnati, Ohio.	99.9 + Pb.	
Lead, Antimonial	Amer. Smelting & Ref. Co., New York, N. Y.	94 Pb; 6 Sb.	Sulphuric, sulphurous, phosphoric, chromic acids.
Lead, Antimonial	Eagle-Picher Co., Cincinnati, Ohio.		Sulphuric, mixed acids; chlorine gas; para-nitrophenol; sodium and zinc chlorides.
Lead, Antimonial	National Lead Co., New York, N. Y.	Pb; 6 Sb.	Sulphurous, sulphuric, phosphoric, chromic acids, hydroxides; chlorides.
Lead, Antimonial	Northwest Lead Co., Seattle, Wash.	93.45 Pb; 6.5 Sb; 0.04-0.08 Cu.	Sulphuric, phosphoric acids; aluminum sulphate; sodium sulphate; ammonium sulphate; mixed acids.
Lead, Chemical	Eagle-Picher Co., Cincinnati, Ohio.		Sulphuric, mixed acids; chlorine gas; para-nitrophenol; sodium and zinc chlorides.
Lead, Chemical	National Lead Co., New York, N. Y.	99.93 Pb; 0.06 Cu; 0.01 Ag; 0.005 Bi.	Sulphurous, sulphuric, phosphoric, chromic acids; hydroxides; chlorides.
Lead, Chemical	Northwest Lead Co., Seattle, Wash.	99.95 Pb; 0.04-0.08 Cu.	Sulphuric, phosphoric acids; aluminum sulphate; sodium sulphate; ammonium sulphate; mixed acids.
Lead, Tellurium	Northwest Lead Co., Seattle, Wash.	99.9 Pb, 0.02-0.06 Te; 0.04-0.08 Cu.	Sulphuric, phosphoric acids; aluminum sulphate; sodium sulphate; ammonium sulphate; mixed acids.
Lead, Tellurium	Eagle-Picher Co., Cincinnati, Ohio.		Sulphuric, mixed acids; chlorine gas; para-nitrophenol; sodium and zinc chlorides.
Lead, Tellurium	National Lead Co., New York, N. Y.	99.85 Pb; 0.04 Te; 0.06 Cu.	Sulphurous, sulphuric, phosphoric, chromic acids; hydroxides; chlorides.
Lukens Clad Steel	Lukens Steel Co., Coatesville, Pa.	Steel clad with Inconel, Monel, nickel or stainless.	
Michiana Stainless	Michiana Products Corp., Michigan City, Ind.	Various standard stainless steels.	
Midvalloy Stainless	Midvale Co., Philadelphia, Pa.	Various standard stainless steels.	
Milwaukee Stainless	Milwaukee Steel Fdry., Milwaukee, Wis.	Various standard stainless steels.	
Nisco Stainless	Michigan Steel Casting Co., Detroit, Mich.	Various standard stainless steels.	
Micro 20	Michigan Steel Casting Co., Detroit, Mich.	Fe; 20 Ni; 20 Cr; 2.5 Mo; 4 Cu.	
Microme Stainless	Michigan Steel Casting Co., Detroit, Mich.	Various standard stainless steels.	
Monel	International Nickel Co., New York, N. Y.	67 Ni; 30 Cu; 1.4 Fe; 0.15 C	Non-oxidizing mineral acids, fixed alkalis, brines and sea water, fatty acids, organic solvents.
Monel-Clad	Lukens Steel Co., Coatesville, Pa.		Acetic, hydrofluoric, oxalic acids, alcohol, butadiene, carbon dioxide.
Munts Metal	Generally available.*	60 Cu; 40 Zn.	
N-3 Metal	Lukenheimer Co., Cincinnati, Ohio.	Cu; 32 Ni; 2.75 Pb; 0.50 Si; 0.75 Mn.	Sludge acid, sulphuric, sea water, slum, salt solutions, garbage liquor.
National Al Alloys	National Smelting Co., Cleveland, Ohio.	Al; 0-4 Cu; 0-4 Mg; 0-7.5 Si; 0-0.6 Mn; 0-1.5 Ni.	
Nag (Nickel Silver)	Mueller Brass Co., Port Huron, Mich.	66 Cu; 10 Ni; 2 Pb; Zn.	
Nichrome	Driver-Harris Co., Harrison, N. J.	60 Ni; 15 Cr; Fe.	Cyanide pots; neutral and alkaline salts; mild hydrochloric, sulphuric, organic acids.
Nichrome V	Driver-Harris Co., Newark, N. J.	80 Ni; 20 Cr.	Neutral and alkaline salts; mild hydrochloric, sulphuric, organic acids.
Nickel	International Nickel Co., New York, N. Y.	99.4 Ni; 0.06 C.	Fixed alkalis, hydrochloric acid, food, phenol, organic solvents, rayon spin solutions.
Nickel L	International Nickel Co., New York, N. Y.	99.4 Ni; 0.01 C	Fused alkalis.
Nickel-Clad	Lukens Steel Co., Coatesville, Pa.		Caustic soda, fatty acids, naphtha, crude phenol, petroleum, pulp and paper, soap.

Nickel Silver, 5, 10, 18%	Generally available.*	65 Cu; 5, 10 or 18 Ni; bal. Zn.	Corrosive atmospheres, hot and cold fresh water, salt water, weak alkalis, organic and weak mineral acids.
Nicloy	Babcock & Wilcox Tube Co., Beaver Falls, Pa.	Fe; 3.5, 5 or 9 Ni.	Alkaline solutions, mild organic acids.
Ni-Hard	International Nickel Co., New York, N. Y.	Fe; 3.4 C; 1.5 Cr; 4.5 Ni; 0.6 Si.	
Nilstain	Wilbur B. Driver Co., Newark, N. J.	Fe; 18-20 Cr; 8-10 Ni; 0.2 max. C; 2 max. Mo.	
Ni-Resist	International Nickel Co., New York, N. Y.	Fe; 2.5 C; 14 or 20 Ni; 6 Cu (optional); 2 Cr; 2 Si.	
Nitex	Driver-Harris Co., Harrison, N. J.	80 Ni; 14 Cr; 6 Fe.	Neutral and alkaline salts; mild hydrochloric, sulphuric, organic acids.
NS-5 Metal	Lunkenheimer Co., Cincinnati, Ohio.	50 Ni; 46 Cu; 2.2 Si; 1.9 Mn.	Corrosion resistance similar to Monel.
Olympic Bronze, Type A	Chase Brass & Copper Co., Waterbury, Conn.	96 Cu; 3 Si; 1 Zn.	Pickling acids and salt brines.
Palladium	Baker & Co., Newark, N. J.	99.99 Pd.	Hydrochloric, sulphuric, hydrofluoric acids.
Palladium	American Platinum Works, Newark, N. J.		
Pennalloy	Pennsylvania Elec. Steel Casting Co., Hamburg, Pa.		
Permite Al Alloys	Aluminum Industries, Cincinnati, Ohio.	Al; 0-5 Cu; 1.5-7.5 Si; 0-1 Fe; 0-0.4 Mg.	
Pioneer	Pioneer Alloy Products Co., Cleveland, Ohio.	65 Ni; Cr; Mo; Fe.	Sulphuric and nitric acids.
Platinum	Baker & Co., Newark, N. J.	99.99 Pt.	Nitric, hydrochloric, sulphuric, hydrofluoric acids; chlorine; bromine.
Platinum	J. Bishop & Co., Malvern, Pa.	99.95 Pt.	
Platinum	American Platinum Works, Newark, N. J.		
Platinum, Iridio	Baker & Co., Newark, N. J.	Pt; 5-30 Ir.	Nitric, hydrochloric, sulphuric, hydrofluoric acids; chlorine; bromine.
Platinum, Iridium	J. Bishop & Co., Malvern, Pa.	Pt; 10-30 Ir.	
Platinum, Rhodio	Baker & Co., Newark, N. J.	Pt; 5-40 Rh.	Nitric, hydrochloric, sulphuric, hydrofluoric acids; chlorine, bromine.
Pyrasteel	Chicago Steel Fdry. Co., Chicago, Ill.	Fe; 25-27 Cr; 12-14 Ni; 0.1-0.35 C; Mn, Cb, Se (optional).	
Pyrosil	Pacific Fdry. Co. Ltd., San Francisco, Calif.	Fe; 28 Cr.	Hot sulphur dioxide atmospheres, cyanide pots, mercuric nitrate.
Pyrosil Stainless	Pacific Fdry. Co. Ltd., San Francisco, Calif.	Various standard stainless steels.	
Refractaloy 26	Westinghouse Electric Corp., Pittsburgh, Pa.	37 Ni; 20 Co; 18 Cr; 3 Mo; 2.9 Ti; 18.1 Fe; 1 Si.	Oxidation resistance at high temperatures.
Refractaloy-70	Westinghouse Electric Corp., Pittsburgh, Pa.	20 Ni; 20 Co; 20 Cr; 13 Fe; 8 Mo; 9 W.	Oxidation resistance at high temperatures.
Reflecto. Brass Forging	Mueller Brass Co., Port Huron, Mich.	59 Cu; 2 Pb; 39 Zn.	
Resistac	Amer. Manganese Bronze Co., Philadelphia, Pa.	90 Cu; 10 Al.	Sulphuric acid, salt solutions and vapors.
Revalon	Revere Copper and Brass, New York, N. Y.	76 Cu; 22 Zn; 2 Al.	Salt and fresh water.
Rex Z-Metal	Chain Belt Co., Milwaukee, Wis.	Iron carbide particles in ferrite matrix.	Sugar cane solution, salt and mine water, sulphuric, tannic and lactic acids.
Lucoloy	Amer. Smelting & Ref. Co., New York, N. Y.	Pb; 0.25 Sn; 0.02 Mg; 0.02 Bi.	
St. Joe Lead	St. Joseph Lead Co., New York, N. Y.	99.90 plus Pb; 0.04-0.08 Cu; 0.002-0.02 Ag; 0.002 max. Fe; 0.001 max. Zn; 0.002 max. As, Sb, Sn.	
Silver	Baker & Co. Inc., Newark, N. J.	99.9 plus Ag.	Sulphuric, hydrofluoric, acetic acids.
Silver	Handy & Harman, New York, N. Y.	99.9 plus Ag.	
Silver	American Platinum Works, Newark, N. J.		
Stainless-Clad Steel	Lukens Steel Co., Coatesville, Pa.	Cladding: 0.07 max. C; 0.75 max. Mn; 1.00 max. Si; 20.00 approx. Cr	Sulphuric acid service; nitric sulphuric mixtures; pickling solutions
Stainless—Clad 304	Lukens Steel Co., Coatesville, Pa.		
Stainless—Clad 316	Lukens Steel Co., Coatesville, Pa.		
Stainless—Clad 347	Lukens Steel Co., Coatesville, Pa.		
Stainless—Clad 410	Lukens Steel Co., Coatesville, Pa.		
Stainless—Clad 430	Lukens Steel Co., Coatesville, Pa.		
Stainless Type 301		Fe; 16-18 Cr; 6-8 Ni; 0.08-0.15 C	Automotive and decorative trim, high tensile cold rolled strip.
Stainless Type 302		Fe; 17-19 Cr; 8-10 Ni; 0.08-0.15 C	Milk, carbonated water, fruit juices, room temp. basic salts, atmosphere.
Stainless Type 302B		Fe; 17-19 Cr; 8-10 Ni; 0.08-0.15 C; 2-3 Si	
Stainless Type 303		Fe; 17-19 Cr, 8-10 Ni; 0.15 max. C, 0.07 min. P, S, Se; 0.6 max. Zr; Mo; 2 max. Mn	Free machining, slightly less corrosion resistant than 302.
Stainless Type 304		Fe; 18-20 Cr; 8-11 Ni; 0.08 max. C, 2 max. Mn	Basic salts; nitric, acetic, fatty acids; sour crudes.
Stainless Type 308		Fe; 19-21 Cr; 10-12 Ni; 0.08 max. C	Sulphite liquors; basic salts; nitrates; nitric, acetic acid.
Stainless Type 309		Fe; 22-24 Cr; 12-15 Ni; 0.2 max. C	Hot oxidizing gases, nitric acid, sour crudes.
Stainless Type 310		Fe; 24-26 Cr; 19-22 Ni; 0.25 max. C	Hot oxidizing gases; sulphur dioxide; nitric, fatty, acetic acids; sour crudes.
Stainless Type 316		Fe; 16-18 Cr, 10-14 Ni; 0.1 max. C; 1.75-2.75 Mo	Hot acetic and fatty acids, sulphite liquor, sulphur dioxide, phosphoric acid, phthalic anhydride, photo emulsions.
Stainless Type 317		Fe; 17.5-20 Cr, 10-14 Ni; 0.1 max. C; 3-4 Mo	Slightly better than 316 because of higher Mo.
Stainless Type 321		Fe; 17-19 Cr; 9-11 Ni; Ti, 8x C min.	High temperature applications.
Stainless Type 347		Fe; 17-19 Cr; 9-12 Ni; Cb, 10x C min.	Same as 304 but for stress relieving or welding of heavy sections.
Stainless Type 403		Fe; 11.5-13 Cr; 0.15 max. C; (turbine quality).	Steam turbine blades.
Stainless Type 405		Fe; 11.5-13.5 Cr; 0.08 max. C; 0.1-0.3 Al	Same as 410 but does not harden appreciably on cooling.
Stainless Type 406		Fe; 12-14 Cr; 0.15 max. C; 3.5-4.5 Al	
Stainless Type 410		Fe; 11.5-13.5 Cr; 0.15 max. C	Hardened valve and pump parts; ammonia, mild fatty, nitric, carbonic acids.
Stainless Type 414		Fe; 11.5-13.5 Cr; 1.25-2.5 Ni; 0.15 max. C	Same as 410 but more responsive to heat treatment.
Stainless Type 416		Fe; 12-14 Cr; 0.15 max. C; 0.07 min. P, S, Se; 0.6 max. Zr, Mo	Free machining, slightly less resistant than 410.
Stainless Type 418		Fe; 12-14 Cr; 0.15 max. C; 2.5-3.5 W	Intermediate high temperature service.
Stainless Type 420		Fe; 12-14 Cr; 0.15 min. C	Cutlery and dental tools.
Stainless Type 430		Fe; 14-18 Cr; 0.12 max. C	Automotive and decorative trim, nitric acid, hot oxidizing gases.
Stainless Type 430F		Fe; 14-18 Cr; 0.12 max. C; 0.07 min. P, S, Se; 0.6 max. Zr, Mo	Free machining, slightly less resistant than 430.
Stainless Type 431		Fe; 15-17 Cr; 1.25-2.5 Ni; 0.2 max. C	Hardenable, resistance approaches 302, paper mill leader bars, Jordan bars.
Stainless Type 440A		Fe; 16-18 Cr; 0.6-0.75 C; 0.75 max. Mo	About same as 410.
Stainless Type 440B		Fe; 16-18 Cr; 0.75-0.95 C; 0.75 max. Mo	About same as 410.
Stainless Type 440C		Fe; 16-18 Cr; 0.95-1.2 C; 0.75 max. Mo	About same as 410.

NOTE: *Listed below are the producers of standard stainless steels for which type analyses have been established by the Amer. Iron and Steel Inst.*

	Allegheny Ludlum Steel Corp., Pittsburgh, Pa.
	Alloy Metal Wire Co., Prospect Park, Pa.
	Amer. Chain & Cable Co., Bridgeport, Conn.
	Amer. Rolling Mill Co., Middletown, Ohio.
	Babcock & Wilcox Tube Co., Beaver Falls, Pa.
	Bethlehem Steel Co., Bethlehem, Pa.
	A. M. Byers Co., Pittsburgh, Pa.
	G. O. Carlson, Inc., Thorndale, Pa.
	Carnegie-Illinois Steel Co., Pittsburgh, Pa.
	Carpenter Steel Co., Reading, Pa.
	Cooper Alloy Fdry. Co., Hillside, N. J.
	Copperweld Steel Co., Warren, Ohio.
	Crucible Steel Co. of America, New York, N. Y.
	Wilbur B. Driver Co., Newark, N. J.
	Eastern Stainless Steel Corp., Baltimore, Md.
	Firth Sterling Steel Co., McKeesport, Pa.
	Globe Steel Tubes Co., Milwaukee, Wis.
	Henry Disston & Sons, Philadelphia, Pa.
	Ingersoll Steel Div., Borg-Warner Corp., New Castle, Ind.
	Jessop Steel Co., Washington, Pa.
	Joslyn Mfg. & Supply Co., Chicago, Ill.
	Latrobe Electric Steel Co., Latrobe, Pa.

Materials	Manufacturer	Description	Most Important Applications
Stainless Type 442	McLouth Steel Corp., Detroit, Mich.	Fe; 18-23 Cr; 0.25 max. C	High temperatures; nitric, fatty, citric acids; plastic molds; acetic anhydride.
Stainless Type 443	Michiana Products Corp., Michigan City, Ind.	Fe; 18-23 Cr; 0.2 max. C; 0.9-1.25 Cu	
Stainless Type 446	Midvale Co., Philadelphia, Pa.	Fe; 23-27 Cr; 0.35 max. C; 0.25 max. N	High temperatures; nitric, citric, lactic acids; acetic anhydride; ammonium phosphate
Stainless Type 501	Pittsburgh Steel Co., Pittsburgh, Pa.	Fe; 4-6 Cr; 0.1 min. C	High temperature oxidation resistance (petrol. refining).
Stainless Type 502	Timken Roller Bearing Co., Canton, Ohio.	Fe; 4-6 Cr; 0.1 max. C	Same as 501.
Stainless Type CA-15	Republic Steel Corp., Cleveland, Ohio.	Fe; 11-14 Cr; 1 max. Ni; 0.15 max. C	Alkaline liquors.
Stainless Type CA-40	Rotary Electric Steel Corp., Detroit, Mich.	Fe; 11-14 Cr; 1 max. Ni; 0.2-0.4 C	Alkaline liquors.
Stainless Type CB-30	Sharon Steel Corp., Sharon, Pa.	Fe; 18-22 Cr; 2 max. Ni; 0.3 max. C	Alcohol, vinegar, fruit juices, oxidizing acids.
Stainless Type CC-35	Stainless Foundry & Engineering Co., Milwaukee, Wis.	Fe; 26-30 Cr; 4 max. Ni; 0.35 max. C	
Stainless Type CC-50	Stanley Works, New Britain, Conn.	Fe; 26-30 Cr; 4 max. Ni; 0.5 max. C	
Stainless Type CD-10M	Sunnorrill Tubing Co., Bridgeport, Pa.	Fe; 27-30 Cr; 3-6 Ni; 0.1 max. C; 2 max. Mo	Sulphurous atmospheres, acid mine water, oxidizing acids, organic acids, sulphite liquor.
	Superior Steel Corp., Carnegie, Pa.		
	Trent Tube Mfg. Co., East Troy, Wis.		
	Universal Cyclops Steel Corp., Bridgeville, Pa.		
	Vanadium Alloys Steel Co., Latrobe, Pa.		
	Wallingford Steel Co., Wallingford, Conn.		
Stainless Type CE-30	NOTE: *Listed below are the producers of standard cast stainless steel for which type analyses have been established by the Alloy Casting Institute.*	Fe; 26-30 Cr; 8-11 Ni; 0.3 max. C	Sulphuric liquors.
Stainless Type CF-7		Fe; 18-20 Cr; 8-10 Ni; 0.07 max. C	
Stainless Type CF-10		Fe; 18-20 Cr; 8-10 Ni; 0.1 max. C	Oxidizing mineral acids, organic acids, salts.
Stainless Type CF-16		Fe; 18-20 Cr; 8-10 Ni; 0.16 max. C	
Stainless Type CF-20		Fe; 18-20 Cr; 8-10 Ni; 0.2 max. C	Sodium hydroxide, alum, mine waters, sulphur dioxide, citric, lactic, acetic acids, brine.
Stainless Type CF-7Se	Allegheny Ludlum Steel Corp., Pittsburgh, Pa.	Fe; 18-20 Cr; 8-10 Ni; 0.07 max. C; 0.2-0.35 Se	
Stainless Type CF-7C	Amer. Cast Iron Pipe Co., Birmingham, Ala.	Fe; 18-20 Cr; 8-10 Ni; 0.07 max. C; 8xC-1 Cb	
Stainless Type CF-7M	American Manganese Steel Div., American Brake Shoe & Fdry. Co., Chicago Heights, Ill.	Fe; 18-20 Cr; 8-10 Ni; 0.07 max. C; 1.5-3.5 Mo	
Stainless Type CF-10M		Fe; 18-20 Cr; 8-10 Ni; 0.1 max. C; 1.5-3.5 Mo	Same as CF-10 but better resistance to pitting.
Stainless Type CF-16M	American Steel Foundries Co., Newark, N. J.	Fe; 18-20 Cr; 8-10 Ni; 0.16 max. C; 1.5-3.5 Mo	
Stainless Type CF-7MC	Atlas Fdry Co., Irvington, N. J.	Fe; 18-20 Cr; 8-10 Ni; 0.07 max. C; 1.5-3.5 Mo; 8xC-1 Cb	
Stainless Type CG-7	Babcock & Wilcox Co., Barberton, Ohio.	Fe; 20-22 Cr; 10-12 Ni; 0.07 max. C	
Stainless Type CG-10	Calorizing Co., Wilkinsburg, Pa.	Fe; 20-22 Cr; 10-12 Ni; 0.1 max. C	Similar but more severe service than CF-10.
Stainless Type CG-16	Chicago Steel Fdry., Chicago, Ill.	Fe; 20-22 Cr; 10-12 Ni; 0.16 max. C	
Stainless Type CG-16 Se	Cooper Alloy Fdry Co., Hillside, N. J.	Fe; 20-22 Cr; 10-12 Ni; 0.16 max. C; 0.2-0.35 Se	
Stainless Type CG-7C	Crane Co., Chicago, Ill.	Fe; 20-22 Cr; 10-12 Ni; 0.07 max. C; 8xC-1 Cb	
Stainless Type CG-7M	Driver Harris Co., Harrison, N. J.	Fe; 20-22 Cr; 10-12 Ni; 0.07 max. C; 1.5-3.5 Mo	
Stainless Type CG-10M	Duraloy Co., Scottdale, Pa.	Fe; 20-22 Cr; 10-12 Ni; 0.1 max. C; 1.5-3.5 Mo	Similar but more severe service than CF-10.
Stainless Type CG-16M	Durion Co., Inc., Dayton, Ohio.	Fe; 20-22 Cr; 10-12 Ni; 0.16 max. C; 1.5-3.5 Mo	
Stainless Type CG-7MC	Electric Steel Fdry. Co., Portland, Ore.	Fe; 20-22 Cr; 10-12 Ni; 0.07 max. C; 1.5-3.5 Mo; 8xC-1 Cb	
Stainless Type CH-10	Electro-Alloys Div., Amer. Brake Shoe Co., Elyria, Ohio.	Fe; 22-26 Cr; 12-15 Ni; 0.1 max. C	Severer service than CF-10 or CG-10.
Stainless Type CH-20	Empire Steel Castings, Inc., Reading, Pa.	Fe; 22-26 Cr; 12-15 Ni; 0.2 max. C	Sulphides.
Stainless Type CH-10C	General Alloys Co., Boston, Mass.	Fe; 22-26 Cr; 12-15 Ni; 0.1 max. C; 8xC-1 Cb	
Stainless Type CH-10M	General Metals Corp., Oakland, Calif.	Fe; 22-26 Cr; 12-15 Ni; 0.1 max. C; 1.5-3.5 Mo	Severer service than CF-10 or CG-10.
Stainless Type CH-20M	Grede Foundries, Milwaukee, Wis.	Fe; 22-26 Cr; 12-15 Ni; 0.2 max. C; 1.5-3.5 Mo	
Stainless Type CH-10MC	Haynes Stellite Co., Kokomo, Ind.	Fe; 22-26 Cr; 12-15 Ni; 0.1 max. C; 1.5-3.5 Mo; 8xC-1 Cb	
Stainless Type CK-25	Hoskins Mfg. Co., Detroit, Mich.	Fe; 23-27 Cr; 19-22 Ni; 0.25 max. C	Marine service, not for reducing acids.
Stainless Type CM-25	Key Co., East St. Louis, Ill.	Fe; 8-11 Cr; 19-22 Ni; 0.25 max. C	
Stainless Type CN-7	Lebanon Steel Fdry., Lebanon, Pa.	Fe; 18-22 Cr; 20-30 Ni; 0.07 max. C; may contain others.	
Stainless Type CN-25	Michiana Products Corp., Michigan City, Ind.	Fe; 18-22 Cr; 20-30 Ni; 0.25 max. C; may contain others.	Reducing acids.
Stainless Type CS-25	Michigan Steel Casting Co., Detroit, Mich.	Fe; 8-12 Cr; 29-32 Ni; 0.25 max. C	
Stainless Type CT-7	Midvale Co., Philadelphia, Pa.	Fe; 13-17 Cr; 34-37 Ni; 0.07 max. C; may contain others.	
Stainless Type CT-25	Milwaukee Steel Fdry., Milwaukee, Wis.	Fe; 13-17 Cr; 34-37 Ni; 0.25 max. C; may contain others.	Reducing acids, mixed acids and salts.
Stainless Type HB	National Alloy Div., Blaw-Knox Co., Blawknox, Pa.	Fe; 18-22 Cr; 2 max. Ni	
Stainless Type HC	Ohio Steel Fdry. Co., Springfield, Ohio.	Fe; 26-30 Cr; 4 max. Ni	Hot gases.
Stainless Type HD	Otis Elevator Co., Buffalo, N. Y.	Fe; 26-30 Cr; 5-6 Ni	
Stainless Type HE	Pacific Fdry. Co., Ltd., San Francisco, Calif.	Fe; 26-30 Cr; 8-11 Ni	
Stainless Type HF	Shawinigan Chemicals, Ltd., Montreal, Que.	Fe; 18-23 Cr; 8-11 Ni	High temperatures.
Stainless Type HH	Steyer Steel Casting Co., Milwaukee, Wis.	Fe; 23-27 Cr; 11-14 Ni	Hot gases.
Stainless Type HI	Standard Alloy Co., Cleveland, Ohio.	Fe; 26-30 Cr; 14-17 Ni	
Stainless Type HK	Sterling Alloys Inc., Woburn, Mass.	Fe; 23-27 Cr; 19-22 Ni	
Stainless Type HL	Symington-Gould Corp., Rochester, N. Y.	Fe; 28-32 Cr; 19-22 Ni	
Stainless Type HN	Taylor Wharton Iron & Steel Co., High Bridge, N. J.	Fe; 18-22 Cr; 23-28 Ni	
Stainless Type HP	Utility Electric Steel Fdry., Los Angeles, Calif.	Fe; 28-32 Cr; 29-31 Ni	Hot gases.
Stainless Type HR	Warman Steel Casting Co., Huntington Park, Calif.	Fe; 8-12 Cr; 29-32 Ni	
Stainless Type HT		Fe; 13-17 Cr; 33-37 Ni	Carburizing service.
Stainless Type HU		Fe; 17-21 Cr; 37-41 Ni	Carburizing service.

Stainless Type 11W		Fe; 10-14 Cr; 58-62 Ni	Carburizing service.
Stainless Type 11X		Fe; 15-19 Cr; 64-68 Ni	Carburizing service.
Stil Metal	Amer. Manganese Bronze Co., Philadelphia, Pa.	Non-ferrous; Co, Cr, W welding rod.	Severe abrasion and heat with sulphuric, nitric, acetic acids; chlorides.
Stoody 1	Stoody Co., Whittier, Calif.	Non-ferrous; Co, Cr, W welding rod.	Abrasion, heat, impact with sulphuric, nitric, acetic acids; chlorides.
Stoody 6	Stoody Co., Whittier, Calif.	69.6 Cu; 30 Ni; 0.4 Fe	
Super Nickel	Amer. Brass Co., Waterbury, Conn.	99.9 + Ta	Hydrochloric, nitric, sulphuric, hydrobromic acids; hydrogen peroxide; ferric chloride.
Tantalum	Fansteel Metallurgical Corp., North Chicago, Ill.	Various standard heat resistant stainless steels.	
Thermalloy Stainless	Electro Alloys Div., Amer. Brake Shoe Co., Elyria, Ohio.	High chromium cast iron.	
Tisco 180 Alloy	Taylor-Wharton Iron and Steel Co., High Bridge, N. J.	13 Mn; 3 Ni	
Tisco Timang Mn Ni Steel	Taylor-Wharton Iron and Steel Co., High Bridge, N. J.	Fe; 12 Mn (Hadfield type).	
Tisco Mn Steel	Taylor-Wharton Iron and Steel Co., High Bridge, N. J.	99.8 Ti, 0.02 N, 0.10 Fe, some O	Similar to stainless steel, except that titanium alloy has a superior resistance to sea water.
Titanium Ti 75A	Titanium Metals Corp. of America, New York, N. Y.		No more susceptible to corrosion than the unalloyed material.
Titanium Ti 150A	Titanium Metals Corp. of America, New York, N. Y.	2.8 Cr, 1.3 Fe, 0.02 N, some O., bal Ti	
Toncan Cu Mo Iron	Republic Steel Corp., Cleveland, Ohio.		
Topbet A	Wilbur B. Driver Co., Newark, N. J.	80 Ni; 20 Cr	
Topbet C	Wilbur B. Driver Co., Newark, N. J.	Fe; 60 Ni; 15 Cr	
Topbet D	Wilbur B. Driver Co., Newark, N. J.	Fe; 35 Ni; 15.5 Cr	
Tri-Clover	Tri-Clover Machine Co., Kenosha, Wis.	Various standard stainless steel fittings.	
Tube Borium	Stoody Co., Whittier, Calif.		
Tuf-Stuf E	Mueller Brass Co., Port Huron, Mich.	89 Cu; 10 Al; 1 Fe	
Tuf-Stuf C	Mueller Brass Co., Port Huron, Mich.	87 Cu; 10 Al; 3 Fe	
Tuf-Stuf H	Mueller Brass Co., Port Huron, Mich.	86 Cu; 11 Al; 3 Fe	
Tuf-Stuf K	Mueller Brass Co., Port Huron, Mich.	80 Cu; 10 Al, 2.5 Fe, 1 Mn; 5 Ni	
U. S. S. Stainless	Carnegie-Illinois Steel Corp., Pittsburgh, Pa.	Various standard stainless steels.	
Utiloy Stainless	Utility Electric Steel Fdry., Los Angeles, Calif.	Various standard stainless steels.	
Utiloy 20	Utility Electric Steel Fdry., Los Angeles, Calif.	20 Cr; 29 Ni; 1.75 Mo; 0.07 max. C	Sulphuric acid, oxidizing and reducing solutions.
Utiloy 100	Utility Electric Steel Fdry., Los Angeles, Calif.	98 Ni; 1.8; 0.25 C	Rayon mfg., caustics.
Utiloy H	Utility Electric Steel Fdry., Los Angeles, Calif.	22-26 Cr; 11-13 Ni; 0.3 C	Hot oxidizing gases, furnace parts, oil still tube supports, cement mill retaining rings.
Utiloy NH	Utility Electric Steel Fdry., Los Angeles, Calif.	14-17 Cr; 34-37 Ni; 0.2-0.6 C	Heat treating boxes, cyanide pots, enamel furnace parts.
Vanadium Stainless	Vanadium Alloys Steel Co., Latrobe, Pa.	Various standard stainless steels.	
Worthite	Worthington Pump and Machinery Corp., Harrison, N. J.	Fe; 20 Cr; 24 Ni; 0.07 max. C; 3.25 Si; 3 Mo; 1.75 Cu; 0.6 Mn	Sulphuric, nitric, phosphoric, acetic acids; sulphate and sulphite paper liquors; citrus juices.
Wrought Iron	A. M. Byers Co., Pittsburgh, Pa.	Fe; 0.03 max. C; 0.05 max. Mn; 0.10-0.12 P; 0.025 max. S; 0.10-0.15 Si; 2.5-3.0 slag	Water, steam and condensate, brines, soil, caustics, corrosive atmospheres.
Wyndaloy	Wyndale Mfg. Corp., Indianapolis, Ind.		

CARBON & GRAPHITE

Impervite	General Ceramics and Steatite Corp., Keasbey, N. J.	Resin impregnated graphite. Mostly for heat exchangers	Hydrochloric, hydrofluoric, phosphoric, chromic, organic acids; ferric chloride.
International	International Graphite and Electrode Corp., St. Mary's, Pa.	Graphite. Electrodes and various shapes.	
Karbate (Carbon)	National Carbon Div., Union Carbon & Carbide Corp., New York, N. Y.	Impervious carbon. Pipe, fittings, valves, pumps, heat exchangers, towers and auxiliary parts, tanks, brick, plates, tubes, special shapes, seal rings, injection parts.	Hydrochloric, sulphuric, phosphoric acids; chlorinated organics; sodium hydroxide; nitric-hydrofluoric acid mixtures.
Karbate (Graphite)	National Carbon Div., Union Carbon & Carbide Corp., New York, N. Y.	Impervious graphite.	
Kempruf Carbon Brick	Electro Chemical Supply and Engineering Co., Emmaus, Pa.	Carbon brick and shapes.	Acids and alkalis.
National Kempruf	National Carbon Div., Union Carbon & Carbide Corp., New York, N. Y.	Carbon. Brick, plates, tubes, cylinders, beams, Raschig rings, pipe, fittings, towers and auxiliary parts, molds, bushings, special shapes.	Hydrochloric, sulphuric, phosphoric acids; sodium hydroxide; nitric-hydrochloric acid mixtures; chlorinated organics.
National Acheson	National Carbon Div., Union Carbon & Carbide Corp., New York, N. Y.	Graphite.	
Speer	Speer Carbon Co., St. Mary's, Pa.	Carbon and graphite. Brick, plates, blocks, tubes, cylinders, bushings, shapes.	
Stackpole	Stackpole Carbon Co., St. Mary's, Pa.	Carbon and graphite. Tubes, pipe, rods, plates, bearings, seal rings, crucibles, heat treating boxes and molds.	
Stackpole	Stackpole Carbon Co., St. Mary's, Pa.	Impervious graphite. Pipe, bearings, seal rings, special shapes (injector body and nozzles).	

CEMENT, MORTAR, PUTTY

Acichlor	Pecora Paint Co., Philadelphia, Pa.	Firm putty.	Hydrochloric, cresic, nitric acids; ammonia; ammonium chloride; caustic soda.
Ardol	The Sullivan Co., Memphis, Tenn.	Pouring cements.	
Acitite	Pecora Paint Co., Philadelphia, Pa.	Ready mixed cement; troweling.	Hydrochloric, acetic, sulphuric, nitric acids; ammonium chloride, benzol.
Alk-Li-Prul	Electro Chemical Supply and Engineering Co., Emmaus, Pa.	Alkali-resistant, synthetic-type cement.	Alkalis; sulphuric, hydrofluoric, hydrochloric, most organic acids; most organic solvents.

Materials	Manufacturer	Description	Most Important Applications
Alkor	Atlas Mineral Products Co., Mertztown, Pa.	Furan derivative; carbon aggregate.	Sulphuric, hydrochloric, hydrofluoric, organic acids; corrosive salts; alkalis.
Atlastic 77	Atlas Mineral Products Co., Mertztown, Pa.	Asphaltic filled cement.	
Asplit	Pennsylvania Salt Mfg. Co., Philadelphia, Pa.	Self-hardening resin cement.	Acids except high oxidizing acids and hydrofluoric.
Basolit, Carbon	Nukem Products Corp., Buffalo, N. Y.	Carbon-sulphur cement.	Hydrofluoric, nitric acids.
Basolit, Standard	Nukem Products Corp., Buffalo, N. Y.	Sulphur silicate based cement	Sulphuric, hydrochloric, other mineral acids except hydrofluoric.
Bru-Bond	Cellrote Co., Cleveland, O.	Sulphur cement; silica aggregate.	Mineral acids, nitric to 30%, weak or cold alkalis and salts.
Bru-Bond (Carbon)	Cellrote Co., Cleveland, O.	Sulphur cement; carbon aggregate.	Mineral acids, nitric to 30%, including hydrofluoric, weak or cold alkalis and salts.
Brimsto	Electro Chemical Supply and Engineering Co., Emmaus, Pa.	Thiokol-sulphur base cement; crushed silica aggregate.	All inorganic acids, except hydrofluoric, over 30% nitric, over 50% sulphuric acids.
Carbo-Fix			
Carbo-Flex			
Carbo-Insulate	Carboline Co., St. Louis, Mo.	(Carbon) Room temperature, thermo-setting carbon cements	Acetic, hydrochloric, sulphuric acids; benzol; chlorinated hydrocarbons; sodium hydroxide.
Carbo-Mold			
Carbo-Korex	Atlas Mineral Products Co., Mertztown, Pa.	Phenol-formaldehyde; carbon aggregate.	Sulphuric, hydrochloric, hydrofluoric, phosphoric, organic acids; corrosive salts.
Carbo Vitrobond	Atlas Mineral Products Co., Mertztown, Pa.	Sulphur-Thiokol cement.	Sulphuric, nitric, hydrochloric, hydrofluoric acids; corrosive salts.
Carbon-Brimsto	Electro Chemical Supply and Engineering Co., Emmaus, Pa.	Thiokol-sulphur base cement; carbon flour aggregate.	All inorganic acids, except hydrofluoric.
Carolina	Charlotte Chemical Laboratories, Charlotte, N. C.	Acidproof cement.	
Caulplit	Pennsylvania Salt Mfg. Co., Philadelphia, Pa.	Self-hardening resin cement.	Most acids and alkalis except high oxidizing acids.
Cellrote Resin Cement	Cellrote Co., Cleveland, Ohio	Furan resin cement with silica and carbon fillers.	Acids, alkalis, salts, esters, most hydrocarbon solvents.
Charlab	Charlotte Chemical Laboratories, Charlotte, N. C.	Chemical putty.	
Cormstone	Johns-Manville Sales Corp., New York, N. Y.	Pressed sheets made from asbestos, cement and inert mineral filler.	Mild acids and alkalis.
Compo-Bond	Cellrote Co., Cleveland, Ohio	Silicate bonding cement, liquid and powder.	Mineral acids, salts, hydrocarbons, mixed solids.
Duralon	U. S. Stoneware Co., Akron, Ohio	Furan base resin cements.	
Durisite	U. S. Stoneware Co., Akron, Ohio	Furan base resin cements.	
Duristone	U. S. Stoneware Co., Akron, Ohio	Furan base flour mastic.	
Duro Standard	Electro Chemical Supply and Engineering Co., Emmaus, Pa.	Sodium silicate cement.	All acids above 3% concentration except hydrofluoric.
Duro XXX (Triplex)	Electro Chemical Supply and Engineering Co., Emmaus, Pa.	Sodium silicate quick-setting cement.	All acids except hydrofluoric.
Duron	Electro Chemical Supply and Engineering Co., Emmaus, Pa.	New type synthetic resin bonds directly to concrete.	All acids, solvents and mild alkalis.
Filtros	Filtros Inc., East Rochester, N. Y.	Acidproof cement.	
Harbauco Bond	Harbison-Walker Refractories Co., Pittsburgh, Pa.	High temperature bonding mortar.	Acid fumes at high temperatures.
Kalso	Maurice A. Knight, Akron, Ohio	A phenolic base resin cement supplied in powder and liquid form, to be mixed when used.	
Kemo Cement	Electro Chemical Supply and Engineering Co., Emmaus, Pa.	210 deg. F. B & R melting point asphalt cement.	All acids, except highly oxidizing ones and alkalis.
Knight # 2 Cement	Maurice A. Knight, Akron, Ohio	A quick-setting silicate cement.	
Knightrobond	Maurice A. Knight, Akron, Ohio	Two sulphur-base cement; No. 6 carbon filler, No. 7 silicate filler.	
Korex	Atlas Mineral Products Co., Mertztown, Pa.	Phenol-formaldehyde; silica aggregate.	Sulphuric, hydrochloric, phosphoric; organic acids; corrosive salts and gases.
Lecite	Electro Chemical Supply and Engineering Co., Emmaus, Pa.	Furan-base resin cement.	All alkalis, solvents, and acids except highly oxidizing ones.
Lumnite	Lumnite Div., Universal Atlas Cement Co., New York, N. Y.	Hydraulic cement; powder for mixing with aggregate and water to make concrete.	Weak sulphuric, lactic, carbonic acids.
N-38 Silicate	Philadelphia Quartz Co., Philadelphia, Pa.	Sodium silicate; to be combined with special proprietary quick-setting cements at time of use.	Sulphuric or any other acid, including organic, except hydrofluoric.
N-Series	Union Bay State Chemical Co., Cambridge, Mass.	Neoprene base cements.	
Neoben TC	Atlas Mineral Products Co., Mertztown, Pa.	Chloroprene polymer cement.	Sulphuric, phosphoric acids; alkalis, corrosive salts.
Nu Mastic	Nukem Products Corp., Buffalo, N. Y.	Asphalt base, high temperature cement.	Hydrochloric, sulphuric, nitric, hydrofluoric acids; alkalis.
Nukem All-Purpose	Nukem Products Corp., Buffalo, N. Y.	Resinous cement; chemical setting.	Sulphuric, hydrochloric, hydrofluoric acids; alkalis.
Nukem Silicate	Nukem Products Corp., Buffalo, N. Y.	Silicate cement.	All acids except hydrofluoric, caustic.
Peromastic	Perora Paint Co., Philadelphia, Pa.	Putty; troweling; brushing.	Hydrochloric, acetic, sulphur acids; caustic soda; ammonia; ammonium chloride.
Penchlor Acid-Proof	Pennsylvania Salt Mfg. Co., Philadelphia, Pa.	Chemical setting silicate cement.	Most acids except hydrofluoric.
Penchlor Acid-Proof 825	Pennsylvania Salt Mfg. Co., Philadelphia, Pa.	Chemical setting silicate cement.	Conc. sulphuric acid.
Penchlor Acid-Proof WR	Pennsylvania Salt Mfg. Co., Philadelphia, Pa.	Chemical setting silicate cement for acids to 1650 deg. F.	Weak acid conditions, except hydrofluoric.
Penchlor FCC	Pennsylvania Salt Mfg. Co., Philadelphia, Pa.	Chemical setting silicate cement.	For acids to 1650 deg. F.
Pennsalt Furan	Pennsylvania Salt Mfg. Co., Philadelphia, Pa.	Self-hardening resin cement.	Most alkalis, solvents and moderately strong acids, except high-oxidizing acids.
Penchlor Fire-Proof	Pennsylvania Salt Mfg. Co., Philadelphia, Pa.	Chemical setting silicate cement.	Acids.
Pennsalt HF and HFK	Pennsylvania Salt Mfg. Co., Philadelphia, Pa.	Self-hardening resin cement.	Food acid: phosphoric, hydrofluoric acids.
Pennsalt PRF and PRFK	Pennsylvania Salt Mfg. Co., Philadelphia, Pa.	Self-hardening resin cement.	Most acids, alkalis and solvents except some high oxidizing acids.
Permanite	Maurice A. Knight, Akron, Ohio	Furan base resin cement.	
Plastite	U. S. Stoneware Co., Akron, Ohio	Caulking putty.	
Plastl Basolit	Nukem Products Corp., Buffalo, N. Y.	Plastirized sulphur-silicate cement.	Sulphuric, hydrochloric, nitric acids.
Porox	Patterson Fdry. & Machine Co., East Liverpool, Ohio	Silicate cement.	
Quigley	Quigley Co., New York, N. Y.	Acidproof cements.	
Reardon	Reardon Industries, Cincinnati, Ohio	Acidproof cement.	
Redux	Rohm & Haas Co., Philadelphia, Pa.	Metal-to-metal resin adhesive.	
Saureisen 31	Saureisen Cement Co., Pittsburgh, Pa.	Acidproof cement. Sodium silicate base.	Acids except hydrofluoric, solvents, water, oil.
Saureisen 44	Saureisen Cement Co., Pittsburgh, Pa.	Acid tank sealer. Non-hardening bituminous base plastic.	Acids except hydrofluoric, water.
Saureisen 46	Saureisen Cement Co., Pittsburgh, Pa.	Hydrofluoric acid cement. Zirconium base melting compsn	All acids, solvents, alkalis, water.
Saureisen 48	Saureisen Cement Co., Pittsburgh, Pa.	Joint compound. Sulphur base melting compounds	Acids except hydrofluoric, solvents, alkalis, water.

Saureisen 40	Saureisen Cement Co., Pittsburgh, Pa.	Resin base melting compound.	Acids except hydrofluoric, solvents, alkalis, water.
Sealtex	Nukem Products Corp., Buffalo, N. Y.	Cold setting rubberized asphaltic compound.	Hydrochloric, sulphuric, nitric, hydrofluoric acids; alkalis.
S Special Silicate	Philadelphia Quartz Co., Philadelphia, Pa.	Low alkaline silicate for use with silica cements.	Sulphuric acid, any acid including organic except hydrofluoric.
Stackpole	Stackpole Carbon Co., St. Mary's, Pa	Carbonaceous cements for carbon, graphite, and carbon-to-metal joints.	
Staminite	Robinson Clay Product Co., Akron, Ohio	Acidproof cement.	
Sulsilo	The Sullivan Co., Memphis, Tenn.	Pre-mixed silicate cement.	
Syntho	Electro Chemical Supply and Engineering Co., Emmaus, Pa.	Phenol-formaldehyde resin cement.	Mild alkalis, solvents, and acids, except highly oxidizing ones.
Thermolith	Harbison-Walker Refractories Co., Pittsburgh, Pa.	Cement.	Alkali resistant at high temperatures.
Thermolith Batch	Harbison-Walker Refractories Co., Pittsburgh, Pa	Cement.	Alkali resistant at high temperatures.
Thiokol	Thiokol Corp., Trenton, N. J.	Liquid (100% solids) rubber polymers.	
Transite	Johns-Manville Sales Corp., New York, N. Y.	Asbestos fiber and cement combined under pressure. Pipe, flat and corrugated sheet.	Acid and alkaline fumes.
Vitrex	Atlas Mineral Products Co., Mertztown, Pa.	Sodium silicate; sets by chemical reaction.	Sulphuric, nitric, hydrochloric acids; corrosive gases.
Vitrobond	Atlas Mineral Products Co., Mertztown, Pa.	Sulphur-Thiokol cement	Sulphuric, nitric, hydrochloric, phosphoric acids; corrosive salts and gases.
Wedgetite	Electro Chemical Supply and Engineering Co., Emmaus, Pa.	Thiokol-sulphur base cement for joining bell and spigot pipe.	All inorganic acids except hydrofluoric, over 30% nitric and over 50% sulphuric acids.

CERAMICS

Ace	Custodis Construction Co., New York, N. Y.	Acidproof brick and packing rings.	Sulphuric, hydrochloric, phosphoric and nitric acids; caustic soda; pickling solutions.
Alsop Glass Lining	Alsop Engineering Co., Milldale, Conn.	Glass-lined tanks, mixers and filters.	
Amersil Fused Silica	Amersil Co., Inc., Hillside, N. J.	Fused silica ware. Pans, pipes, gas coolers, absorbers, insulators tubes, plates.	
Carrara	Pittsburgh Plate Glass Co., Pittsburgh, Pa.	Structural glass, flat or bent.	
Cerathern	U. S. Stoneware Co. Akron, Ohio	Ceramic ware. Process equipment.	
Cerraware	General Ceramics and Steatite Corp., Keasbey, N. J.	Chemical stoneware. Towers, tanks, pumps, etc.	Hot, wet chlorine; hydrochloric, nitric acids; hydrogen peroxide; bromine; sodium hypochlorite.
Cerawite	General Ceramics and Steatite Corp., Keasbey, N. J.	Chemical porcelain. Piping, valves, etc.	Hydrogen peroxide; hydrochloric, nitric, organic, sulphuric acids; aqua regia.
Clayercraft	Clayercraft Co., Columbus, Ohio	Acidproof brick.	Common acids and alkalis, any concentration.
Duro	Harbison-Walker Refractories Co., Pittsburgh, Pa.	Vitreous, acidproof brick.	Sulphuric, hydrochloric, nitric acids; organic acids; certain alkaline solutions.
Fiberglas	Owens-Corning Fiberglas Corp., Toledo, Ohio	Fibrous glass cloth and mat. Air filters, thermal insulation, tower packing, filter cloth.	
Glasrote	Glasrote Products, Inc., Cleveland, Ohio	Borosilicate glass lining fused to steel.	Hydrochloric, organic, sulphuric, nitric acids; chlorine; pharmaceuticals.
H-W Chromex Refractory	Harbison-Walker Refractories Co., Pittsburgh, Pa.	Lactic-carbonic.	
H-W Castables	Harbison-Walker Refractories Co., Pittsburgh, Pa.	Lactic-carbonic.	
Hanovia Fused Quartz	Hanovia Chemical & Mfg. Co., Newark, N. J.	Transparent fused quartz in all shapes	
Illinois	Illinois Electric Porcelain Co., Macomb, Ill.	Ceramic chemical porcelain. Pipe, valves, fittings.	Acids (except hydrofluoric).
Knight-Ware	Maurice A. Knight, Akron, Ohio	Chemical stoneware. Tanks, kettles, pipe, fittings, valves, towers, coils, filters, etc.	
Lapp Porcelain	Lapp Insulator Co., Le Roy, N. Y.	Chemical porcelain. Pipe, fittings, valves, tower packing, special shapes.	Hydrochloric, sulphuric, nitric acids; mixed acids; chlorinated hydrocarbons; wet chlorine.
Locke Porcelain	Locke Inc., Baltimore, Md.	Chemical porcelain. Balls for ball mills, brick, piping, valves, containers.	All acids except hydrofluoric.
Penn-vernon	Pittsburgh Plate Glass Co., Pittsburgh, Pa.	Window glass, flat.	
Permaclas	A. O. Smith Corp., Milwaukee, Wis.	Glass-lined steel equipment.	
Pfaudler	The Pfaudler Co., Rochester, N. Y.	Glass-lined steel equipment. Tanks, pipe, fittings, valves.	Hydrochloric, sulphuric nitric, phosphoric, acetic, chromic acids.
Pittsburgh Plate Glass	Pittsburgh Plate Glass Co., Pittsburgh, Pa.	Polished plate glass, flat or bent.	
Pyrex	Corning Glass Works, Corning, N. Y.	Glass. Pipe, fittings, sight glasses, gage glasses, heat resistant plate.	
"U. S." Chemical Stoneware	U. S. Stoneware Co., Akron, Ohio	Chemical stoneware. Tanks, kettles, pipe, fittings, valves, pumps, coils, filters, etc.	
"U. S." Chemical Porcelain	U. S. Stoneware Co., Akron, Ohio	Chemical porcelain filters, tanks, pumps, valves, etc.	
Vitreo	Vitreous Steel Products Co., Cleveland, Ohio	Porcelain enamel drying trays.	Blue trays: neutral salts and solutions. Brown trays: acids except hydrofluoric and certain grades of hot phosphoric.
Vitrosil	The Thermal Syndicate Ltd., New York, N. Y	Vitreous silica, approx. 99 5% silica: pipes and vessels up to 50 gal. capacity; 30 in. dia., 10 ft. length.	Hydrochloric, phosphoric, perchloric, nitro-hydrochloric acids; chlorine; phosgene.
Vitreous Enamel	Vitreous Enameling & Stamping Co., New York, N. Y.	Enameled tanks and specialities.	
Vycor	Corning Glass Works, Corning, N. Y.	96% Silica glass. Tubing, rods, flat ware, various shapes.	
Wylam Acid	Harbison-Walker Refractories Co., Pittsburgh, Pa.	Acidproof brick.	Sulphuric, hydrochloric, nitric and organic acids; certain alkaline solutions.

PLASTICS

Alathon	E. I. du Pont de Nemours & Co., Wilmington, Del.	Polyethylene. Sheet, rod, tube, molding powders, film, filament. Pipe, pipe lining, gaskets, etc.	Relatively strong alkalis and acids, most nonhydrocarbon solvents, water.
Amperet	American Molding Powder and Chemical Corp., Brooklyn, N. Y.	Cellulose acetate molding powder; polystyrene molding powder.	

Materials	Manufacturer	Description	Most Important Applications
Araldite	Ciba Company, Inc., New York, N. Y.	Ethoxyline resin. Adhesives, coatings and casting resins.	Hydrochloric and phosphoric acids, potassium hydroxide, chlorine compounds and chlorine.
Catalin	Catalin Corp. of Amer., New York, N. Y.	Cast phenol-formaldehyde resin.	Sulphuric, phosphoric, nitric, acetic acids; aliphatic hydrocarbons; copper sulphate.
DC 2103	Dow Corning Corp., Midland, Mich.	Silicone bonding resin for plastic laminates.	Sulphuric, hydrochloric, chromic acids; sodium hydroxide; hydrogen peroxide.
Durez Copolymers # 3, # X34, # 41E	Dewey & Almy Chemical Co., Cambridge, Mass.	High styrene copolymers.	Sulphuric acid, moisture acids, alkalis, oils, solvents, resistant to aging and to softening at high temperatures.
Durez Copolymers # 56L	Dewey & Almy Chemical Co., Cambridge, Mass.	Polyvinyl acetate emulsion.	Water, common solvents, acids and alkalis, amyl and n-hexyl alcohol, ethylene glycol, glycerine, aliphatic hydrocarbons.
Durez	Durez Plastics & Chemicals, Inc., N. Tonawanda, N. Y.	Molding compound (granular) and resins (lump, liquid, powder) (phenol-formaldehyde condensates).	Mild acids and alkalis, petroleum and lacquer solvents, vegetable oils.
Fortiflex	Celanese Corp. of America, New York, N. Y.	Cellulose propionate.	Fair resistance to dilute acids, bases, salts.
Geon	B. F. Goodrich Chemical Co., Cleveland, Ohio	Polyvinyl chloride-type resins, plastics, latices.	Sodium hydroxide, sulphuric, nitric, hydrochloric and hydrofluoric acids; aromatic, aliphatic hydrocarbons; salt solutions; water; oxidizing, reducing agents.
G-E Molded	General Electric Co., Pittsfield, Mass.	Phenolic, modified phenolic or rubber phenolic. Wood flour, cotton flock, rag or mineral filled.	Dilute acids, bases, hydrocarbons, rayon precipitates, inorganic solvents, alcohol.
Gering Polyethylene	Gering Products Inc., Kenilworth, N. J.	Polyethylene molding powder or extruded shapes.	All acids, all alkalis, all cold solvents.
Gering Vinyl	Gering Products Inc., Kenilworth, N. J.	Polyvinyl chloride molding powder or extruded shapes.	Most acids, most alkalis.
Haveg 41	Haveg Corp., Newark, Del.	Molded, asbestos-filled phenolic.	Non-oxidizing acids, salts, hydrocarbons and other solvents.
Haveg 43	Haveg Corp., Newark, Del.	Molded, graphite-filled phenolic.	Hydrofluoric acid and its compounds.
Haveg 60	Haveg Corp., Newark, Del.	Molded, asbestos filled furan.	Non-oxidizing acids, salts, alkalis, alcohols, esters, hydrocarbons and other solvents.
Hermite	Hermite & Chemical Co., Manitowoc, Wis.	Pure phenol—formaldehyde resin.	Sulphuric, organic, fatty acids; all solvents.
Kel-F	The M. W. Kellogg Co., Jersey City, N. J.	Trifluorochloroethylene polymers (oils, greases, waxes, molding powders, dispersions).	Chemically inert to all strong and weak acids, strong and weak alkalis, both organic and inorganic.
Koroseal	B. F. Goodrich Co., Akron, Ohio	Plasticized polyvinyl chloride. Sheet lining; packing.	Chromic, nitric acid; chrome plating solutions.
Krastic	Naugatuck Chemical Div., U. S. Rubber Co., Naugatuck, Conn.	Rigid thermoplastic combination of acrylonitrile modified resins and rubber elastomers.	High impact resistance and good chemical resistance to sodium hydroxide, mineral acids, aliphatic hydrocarbons.
Lucite	E. I. du Pont de Nemours & Co., Wilmington, Del.	Acrylic resin; sheets, rods, tubes, moldings.	Weak alkalis and acids, aliphatic hydrocarbons.
Lumarith	Celanese Corp. of America, New York, N. Y.	Cellulose acetate.	Good resistance to fats, waxes; fair to dilute acids, bases, salts, aliphatics.
Lumpane	Celanese Corp. of America, New York, N. Y.	Thermal and electrical insulation. Wire laminated between cellulose acetate sheets.	Good resistance to fats, waxes; fair to dilute acids, bases, salts, aliphatics.
Marvinol	Naugatuck Chemical Div., U. S. Rubber Co., Naugatuck, Conn.	Thermoplastic polyvinyl chloride resins.	Flame-proof rigid and elastomeric products resistant to alkalis, mineral acids, aliphatic and aromatic hydrocarbons, alcohol.
Micarta	Westinghouse Electric Corp., Pittsburgh, Pa.	Laminated plastics, fabric or kraft base. Sheets, channels, angles, molded shapes.	Mild acids, alkalis, organic solvents, water, atmospheric conditions.
Nixon CA (Nixonite)	Nixon Nitration Works, Nixon, N. J.	Cellulose acetate. Sheets, rods, molding powders.	
Nixon CN (Nixonoid)	Nixon Nitration Works, Nixon, N. J.	Cellulose nitrate. Sheets, rods, tubes.	
Nixon EC	Nixon Nitration Works, Nixon, N. J.	Ethyl cellulose. Molding powders.	
Nylon	E. I. du Pont de Nemours & Co., Wilmington, Del.	Polyamides; flake, sheet, extrusions, moldings; brush filaments.	Alkalis, esters, ketones, some types resistant to alcohols, most solvents and weak acids.
Plexiglas	Rohm & Haas Co., Philadelphia, Pa.	Acrylic resin. Cast sheets, rods, molding powder.	Alkalis, non-oxidizing acids, salt water, photographic solutions, low concentrations of alcohol.
Saran	Dow Chemical Company, Midland, Mich.	Vinyl chloride-vinylidene chloride copolymer. Pipe, pipe fittings, tube, tube fittings.	Hydrochloric, sulphuric, nitric acids; phenol; aliphatic and aromatic hydrocarbons.
Selectron	Pittsburgh Plate Glass Co., Pittsburgh, Pa.	Thermosetting plastic.	
Teflon	E. I. du Pont de Nemours & Co., Wilmington, Del.	Polytetrafluoroethylene. Rods, tubes, sheets, bonding, gaskets, thin tapes.	Everything except molten alkali metals.
Tenite I	Tennessee Eastman Corp., New York, N. Y.	Cellulose acetate thermoplastic molding material.	Fair resistance: water, dilute acids, bases, salts, aliphatic petroleum products.
Tenite II	Tennessee Eastman Corp., New York, N. Y.	Cellulose acetate butyrate thermoplastic molding material.	Good resistance: fats, waxes.
Textolite Laminated	General Electric Co., Pittsfield, Mass.	Phenolic, melamine and silicone laminates. Paper, fabric, asbestos or glass base.	Dilute acids, bases, hydrocarbons, rayon precipitates, inorganic solvents, alcohol.
Uscolite	U. S. Rubber Co., New York, N. Y.	Thermoplastic pipe and fittings.	
Vibrin	Naugatuck Chemical Div., U. S. Rubber Co., Naugatuck, Conn.	Thermosetting compositions of polyesters and crosslinking monomers used in laminating low pressure molding and casting.	High strength composites in glass cloth laminates. Types of series are flameproof, resistant to acids, alkalis, aromatic and aliphatic hydrocarbons.
Vinylite	Celanese Corp. of America, New York, N. Y.	Mesh reinforced plastic.	Good resistance to fats, waxes; fair to dilute acids, bases, salts, aliphatics.
Westinghouse Micarta	Westinghouse Electric Corp., Pittsburgh, Pa.	Laminated sheets, rods, tubes, special shapes.	Mild acids, alkalis, organic solvents, water, atmosphere.

REFRACTORIES

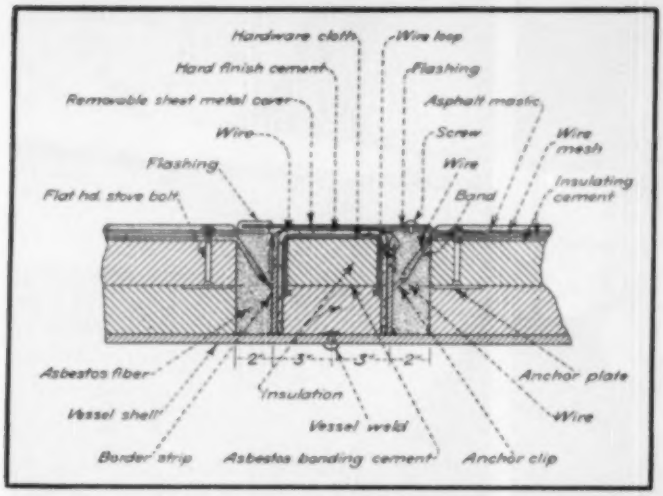
Alfrax K	The Carborundum Co., Refractories Div., Perth Amboy, N. J.	90% electrically fused aluminum oxide plus minor amounts of bonding materials. Brick, shapes and cements.	Hydrogen, carbon monoxide, coarse flyash, hydrocarbons, combustion gases—all at high temperatures.
Alfrax 2304	The Carborundum Co., Refractories Div., Perth Amboy, N. J.	99% electrically fused aluminum oxide. Brick and shapes.	Hydrogen, hydrocarbons, combustion gases—all at high temperatures.

Alonite	The Carborundum Co., Refractories Div., Perth Amboy, N. J.	Ceramically bonded, fused crystalline alumina grain, in proportion of 15:85. Porous plates and tubes.	Water filtration, acid filtration, including all acids except hydrofluoric, and air and gas diffusion into liquids.
Amersil, Fused Silica	Amersil Company, Inc., Hillside, N. J.	Silicon dioxide. Opaqued and transparent.	All acids, except hydrofluoric and phosphoric (above 400 deg. C.). Most pure molten metals. Most important: hydrochloric, sulphuric and nitric acids; chlorine; magnesium; aluminum.
Amersil, Fused Quartz	Amersil Company, Inc., Hillside, N. J.	99+. Opaqued and transparent.	All acids, except hydrofluoric and phosphoric (above 400 deg. C.). Most pure molten metals. Most important: hydrochloric, sulphuric and nitric acids; chlorine, magnesium; aluminum.
Carbofrax	The Carborundum Co., Refractories Div., Perth Amboy, N. J.	85% SiC and minor amounts of bonding materials. Silicon carbide brick, shapes and cements.	Hydrochloric acid, combustion gases, hydrocarbons, hydrogen, sulphuric acid, and carbon monoxide—all at elevated temperatures.
Ceraware	General Ceramics and Steatite Corp., Keasbey, N. J.	Chemical stoneware.	Chlorine, hydrochloric acid, bromine, iodine, sulphuric acid, and all organic acids.
Cerawite	General Ceramics and Steatite Corp., Keasbey, N. J.	High-fired chemical porcelain.	Chlorine, hydrochloric acid, bromine, iodine, sulphuric acid, and all organic acids.
Corhart Electroplast	Corhart Refractories Co., Louisville, Ky.	Ramming mix, mullite-corundum base. Therm lsetting.	Acid fumes at high temperatures.
Corhart Standard Electrocast	Corhart Refractories Co., Louisville, Ky.	Mortar, mullite-corundum base. Thermal setting.	Acid fumes at high temperatures.
Corhart Standard Electrocast	Corhart Refractories Co., Louisville, Ky.	Refractory blocks, mullite-corundum base. Thermal setting.	Acid fumes at high temperatures.
Corhart Zac Electrocast	Corhart Refractories Co., Louisville, Ky.	Refractory blocks, zirconia-corundum. Fused cast.	Molten magnesium chloride.
Monofrax	The Carborundum Co., Refractories Div., Perth Amboy, N. J.	Fused cast alumina refractories. Brick and blocks.	Molten slags, molten glasses, molten metallic oxides, molten metallic silicates, combustion gases and chlorine—all at high temperatures.
Mullfrax	The Carborundum Co., Refractories Div., Perth Amboy, N. J.	Bonded electric furnace mullite. Brick, shapes, and cements.	Steam, hydrogen, carbon monoxide, hydrocarbons—all at high temperatures—sulfites coal and oil ashes.
Permanente Periclase, Chrome Periclase, Periclase Chrome Refractory Brick, Mortars & Ramming Mixes	Kaiser Aluminum & Chemical Corp., Chemical Div., Oakland, Calif.	Magnesia and magnesia-chrome brick, mortars, ramming mixes and castable materials (made from high purity synthetic MgO)	Resists oxidizing atmospheres and extremely high temperatures. Used in contact with basic materials in steel and non-ferrous metal furnaces, rotary kilns, glass furnaces, pulping furnaces, etc.
Refrax	The Carborundum Co., Refractories Div., Perth Amboy, N. J.	Mainly silicon carbide with bonding materials. Special shapes.	Hydrogen cyanide, combustion gases, hydrocarbons—all at high temperatures.
Shamva	Mullite Refractories Co., Shelton, Conn.	Mullite-sillimanite type refractories.	Acid fumes at high temperatures.
Taylor Zircon	Chas. Taylor Sons Co. Refractories Cincinnati, Ohio.	Refractory products made entirely of refined zirconium-silicate.	Calcium metaphosphate, sodium phosphate, sulphuric acid.
Transite, corrugated & flat	Johns-Manville Sales Corp., New York, N. Y.	Made of asbestos and cement, these materials come in large sheets that are structurally strong.	Withstands corrosive action of many liquids, condensates, gases, dusts, vapors and fumes.
Walsh H & B Castable	Walsh Refractories Corp., St. Louis, Mo.	Hydraulic setting, mix and pour castable.	Acid fumes at high temperatures.
Walsh Hi-Lumite	Walsh Refractories Corp., St. Louis, Mo.	Fire brick.	Acid fumes at high temperatures.
Walsh Mort-Airset	Walsh Refractories Corp., St. Louis, Mo.	Airsetting high temperature bonding mortar.	Acid fumes at high temperatures.
Walsh Mullite Fire Brick	Walsh Refractories Corp., St. Louis, Mo.	Super duty fire clay brick.	Where unusually high temperatures and severe conditions are encountered.
Walsh Plastic Furnace Lining	Walsh Refractories Corp., St. Louis, Mo.	Plastic firebrick.	Acid fumes at high temperatures.

RUBBER

Ace Hard Rubber	Amer. Hard Rubber Co., Butler, N. J.	Vulcanized rubber. Rod, sheet, tube, molded parts, linings, pipe, fittings, etc.	Sulphuric, hydrochloric, phosphoric, acetic acids; caustics; salt solutions.
Ace Soft Rubber	Amer. Hard Rubber Co., Butler, N. J.	Soft rubber. Linings, molded parts.	Sulphuric, hydrochloric, phosphoric acids; caustics; salt solutions.
Acidseal E	B. F. Goodrich Co., Akron, Ohio	Natural rubber sheet lining for tanks and misc. metal parts.	Bleach solutions; highly corrosive acid mixtures.
Acidseal MA and PA	B. F. Goodrich Co., Akron, Ohio	Natural rubber sheet lining for tanks and misc. metal parts.	Hydrochloric and phosphoric acids; respectively.
Armstrong	Armstrong Cork Co., Lancaster, Pa.	Buna-N base gaskets.	Aromatic fuels, alkalis, mild acids, alcohols, inorganic salts.
Armstrong	Armstrong Cork Co., Lancaster, Pa.	Neoprene base gaskets.	Alkalis, inorganic salts, mild acids, refined petroleum oils.
Armstrong	Armstrong Cork Co., Lancaster, Pa.	Cork-buna N base gaskets.	Aromatic fuels, vegetable and petroleum oils.
Armstrong	Armstrong Cork Co., Lancaster, Pa.	Cork-neoprene base gaskets.	Vegetable and petroleum oils.

Materials	Manufacturer	Description	Most Important Applications
Armstrong	Armstrong Cork Co., Lancaster, Pa.	Cork-Thiokol gaskets.	Aromatic solvents, ammonium alcohols.
Atlastavrm 10	Atlas Mineral Products Co., Mertztown, Pa.	Chloroprene polymer linings.	Sulphuric, phosphoric acids; alkalis, corrosive salts.
Boston	Boston Woven Hose & Rubber Co., Boston, Mass.	V-belts, conveyor and transmission belt, hose, mechanical goods.	
Cruse	Cruse Packing Co., Chicago, Ill.	Packing and mechanical seals.	
Custoplast	Custodis Construction Co., New York, N. Y.	Soft rubber and neoprene tank linings.	
Dayton	Dayton Rubber Co., Dayton, Ohio	Oilproof rubber V-belt, transmission belt.	
Duro-bond	Electro Chemical Supply & Engineering Co., Emmaus, Pa.	Seamless natural rubber lining.	All acids except highly oxidizing ones.
Duro-prene	Electro Chemical Supply & Engineering Co., Emmaus, Pa.	Seamless synthetic rubber lining.	All acids except highly oxidizing ones.
Firestone	Firestone Tire & Rubber Co., Akron, Ohio	Vibration dampeners, adhesives, sheet, tape, hose, belting, fabric, moldings, extrusions, foamed latex, rubber thread.	
Garlock	Garlock Packing Co., Palmyra, N. Y.	Gaskets, packings, moldings, Klozure oil seals.	
Gates	Gates Rubber Co., Denver, Colo.	Belts, hose, moldings.	Dilute acids and alkalis, mineral oils, chlorinated hydrocarbons, organic peroxides, alcohols.
G. E. Silicone Rubber	General Electric Co., Pittsfield, Mass.	Sheets, extruded shapes, molded parts, coating pastes, foam, gaskets.	Dilute acids and alkalis, mineral oils, chlorinated hydrocarbons, organic peroxides, alcohols.
Greene-Tweed	Greene, Tweed & Co., No. Wales, Pa.	Packing, gaskets, sheet.	
Hereral	Hereite & Chemical Co., Manitowoc, Wis.	Butadiene acrylonitrile product. Vulcanized or uncompounded.	Hydrochloric acid, oils, gasoline.
Hewitt	Hewitt Rubber Div., Hewitt-Robins, Inc., Buffalo, N. Y.	Hose, belting.	Acid, alkali, air, water, steam.
Hycar OR	B. F. Goodrich Chemical Co., Cleveland, Ohio	Nitrile type synthetic rubber.	Aromatic, aliphatic hydrocarbons; alkaline, acidic and neutral salt solutions; alcohols and esters; vegetable and mineral oils; alkali solutions.
Hycar PA	B. F. Goodrich Chemical Co., Cleveland, Ohio	Polyacrylic ester-type synthetic rubber.	Hot animal and vegetable oils, aliphatic hydrocarbons, air, ozone.
Jenkins	Jenkins Bros. Rubber Div., New York, N. Y.	Valve disks, tape, moldings, extrusions.	
Johns Manville	Johns-Manville Sales Corp., New York, N. Y.	Gaskets.	
Linear	Linear Packing & Rubber Co., Philadelphia, Pa.	Packing.	
Lusetne	Lusetne Rubber Co., Trenton, N. J.	Hard rubber pipe, fittings, valves, shapes, tanks, lining.	Alkalis; hydrochloric, sulphuric, nitric acids.
Magi-Vulc	Magic Chemical Co., Brockton, Mass.	Linings, coatings, cements.	
Manhattan	Raybestos Manhattan, Inc., Manhattan Rubber Div., Passaic, N. J.	Crude and synthetic rubber linings.	Inorganic acids (except highly oxidizing), salts, alkalis; organics except aliphatic, aromatic and chlorinated hydrocarbons.
Neoben	Atlas Mineral Products Co., Mertztown, Pa.	Neoprene-base lining for tanks, fans, fume ducts, etc.	Sulphuric, phosphoric acids; alkalis; corrosive salts.
Neoprene	E. I. du Pont de Nemours & Co., Wilmington, Del.	Crude polymer of chloroprene for compounding and curing.	Caustic solutions, plating solutions, aliphatic hydrocarbons, animal and vegetable fats and oils, dilute mineral acids.
Neoprene	Custodis Construction Co., New York, N. Y.	Synthetic rubber acidproof membrane.	Sulphuric acids, caustic soda, bleach solutions, alcohols.
Paraeril	Enjay Co., Inc., New York, N. Y.	Copolymer of butadiene and acrylonitrile. Solid sheets.	Aliphatic hydrocarbons; animal, vegetable and petroleum oils.
Paraply	U. S. Stoneware Co., Akron, O.	Synthetic rubber compounds.	
Paramount	Paramount Rubber Co., Detroit, Mich.	Neoprene, buna-S, natural rubber. Sheets for tank lining.	
Parlon	Hercules Powder Co., Wilmington, Del.	Chlorinated rubbers. Used as a base for concrete paints.	
Permobond Natural (soft)	U. S. Rubber Co., New York, N. Y.	Linings for tanks, pipes, fittings, valves.	Majority of industrial chemicals except strong oxidizing agents such as nitric and chromic acid, pickling baths, hot acid baths, withstand temperature to 180 deg. F., special compounds up to 210 deg. F.
Permobond Natural (hard)	U. S. Rubber Co., New York, N. Y.		
Permobond GR-S (soft)	U. S. Rubber Co., New York, N. Y.		
Permobond GR-S (hard)	U. S. Rubber Co., New York, N. Y.		
Permobond GR-A (soft)	U. S. Rubber Co., New York, N. Y.		
Permobond GR-A (hard)	U. S. Rubber Co., New York, N. Y.		
Permobond GR-M (soft)	U. S. Rubber Co., New York, N. Y.		
Permobond GR-P (soft)	U. S. Rubber Co., New York, N. Y.		
Permobond GR-I	U. S. Rubber Co., New York, N. Y.		
Pliovid	Goodyear Tire & Rubber Co., Akron, Ohio	Rubber-lined tanks, pipe, etc.	Hydrochloric, sulphuric, hydrofluoric acids; wet chlorine; bleach solutions; plating solutions.
Rewbon	Atlas Mineral Products Co., Mertztown, Pa.	Natural rubber.	Sulphuric, hydrochloric, hydrofluoric, phosphoric acids; alkalis; corrosive salts.
Sanprene	B. F. Goodrich Co., Akron, Ohio	Natural rubber sheet lining for tanks and misc. metal parts.	Food products.
Silastic	Dow Corning Corp., Midland, Mich.	Silicone rubber compounded with inorganic fillers.	Hot oils; ozone; hydrochloric, nitric, sulphuric acids; sodium hydroxide
Superflexite	B. F. Goodrich Co., Akron, Ohio	Flexible, natural rubber sheet lining for tanks and misc. metal parts.	Bleach solutions; highly corrosive acid mixtures.
Stokes	Stokes Molded Prods, Trenton, N. J.	Hard rubber pipe, containers, fittings, misc. moldings and extrusions.	Acids, metallic salt solutions, chlorine solutions, ammonia, caustics.
Tenaigrip	Amer. Wringer Co., Woonsocket, R. I.	Natural and synthetic rubber lined tanks, pipe, pumps, ducts, etc.	
Thermoid	Thermoid Rubber Div., Trenton, N. J.	Rubber hose; various types.	Ammonia, beer and wine, butane-propane gas, CO_2, lactic acid, hydraulic oils, oil and gasoline, lacquers, steam.
Thiokol	Thiokol Corp., Trenton, N. J.	Organic polysulphide rubber. Forms: solid, water dispersion or viscous liquid.	Aliphatic and aromatic hydrocarbons, chlorinated compounds, ketones.
Trilles	B. F. Goodrich Co., Akron, Ohio	Hard rubber layer sandwiched between two soft rubber layers. Sheet lining for tanks and misc. metal parts.	Pickling solutions, alum, hydrochloric and sulphuric acids.
Vistanex	Enjay Co., Inc., New York, N. Y.	Polymerized isobutylene. Viscous liquid to solid, depending on mol. wt.	Sat. sodium chloride, aq. ammonia, aq. ammonium sulphate, aq. lead acetate, 30% hydrochloric acid, 60% hydrofluoric acid, 40% potassium hydroxide, 60% sulphuric acid, 38% sulphuric acid + 14% nitric acid.
Vulcalock	B. F. Goodrich Co., Akron, Ohio	Adhesive for rubber-to-steel bonding.	Hydrochloric and sulphuric acids.
Vulcanized	Vulcanized Rubber Co., New York, N. Y.	Hard and semi-hard moldings.	



Cross section diagram shows how removable insulation panel is provided over welded vessel joint, and how expansion joint is constructed to allow for high temperature operation of the vessel without insulation damage.

How to Apply Removable Insulation Over Process Vessel Welds

Use of removable insulating panels over welded vessel joints saves re-insulation when joints must be inspected.

MARSHALL A. ALLEN

Where process equipment is subject to high temperatures and stresses, and especially if the material handled is corrosive, it is desirable to examine and test the vessel welds periodically. To avoid high re-insulation costs, removable insulation must be provided over the weld seams. Also, because of the temperatures involved, expansion joints are needed in the insulation to allow for both lateral and longitudinal expansion of the vessel. The method shown here solves both of these problems and has proved successful over a period of years. It makes use of permanent insulation on the vessel shell plates, removable insulation over weld inspection lanes, and sheet metal jacketing. The insulating material employed is 85 percent magnesia, applied alone, or in combination with diatomaceous silica.

Before the insulation is applied, metal border strips are tack-welded to each vessel shell plate about 3 in. from and parallel to the vertical and horizontal welds, as the accompanying cross section drawing shows. These strips thus form a closed figure, generally rectangular in shape.

A layer of insulation blocks with the long dimension in the vertical position is then applied inside the rectangle. The blocks are butted against the horizontal border strips, but a 2-in. space is left for the expansion joints between the insulation and the vertical strips on either side. The blocks are fastened in place with wiring tied to clips provided on the vertical strips.

Anchor plates, to which threaded stove bolts have been tack-welded at 1-ft. intervals along the center, are then slipped in place between the insulation tie wires and the insulating blocks. A second layer of blocks is applied by forcing them onto the stove bolts until the bolts protrude. It is further secured by means of horizontal bands anchored to the vertical border strips.

The insulation is then finished in the usual manner with cement or weather-resistant asphaltic mastic, depending upon equipment location.

When this part of the procedure is completed, every vessel shell plate has been individually insulated and a 3-in. uninsulated area has been left at both sides of the vessel welds, providing inspection lanes 6 in. wide. Construction of removable insulation panels follows.

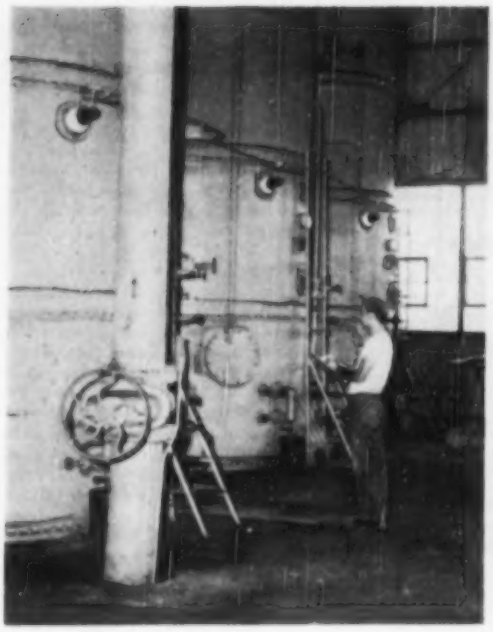
A double layer of insulation blocks is arranged to form a rectangle 6 in. wide and 3 ft. long, held together with asbestos bonding cement, and covered with hardware cloth. The edges of the hardware cloth are bent and hammered into the sides of the under layer of block so that the two layers will be held together as a unit. Hard-finish cement is applied over the entire unit and the panel is ready for installation. Placed over the welds between the border strips, the panels are secured with wires anchored to the border strips.

Asbestos fibrous insulation is now packed tightly into the 2-in. spaces left between the permanently installed insulation and the vertical border strips on the vessel shell plates, to allow for expansion of the vessel.

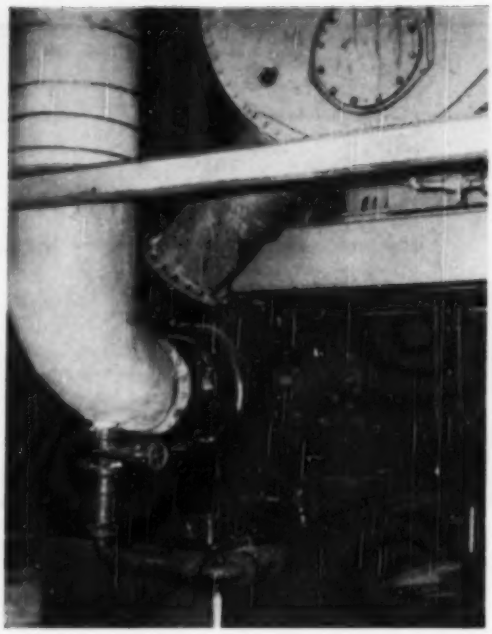
Metal flashing strips, 6 in. wide, are used as a finish for the fibrous insulation. At one side of the vertical inspection lanes, flashing with a crimp forming a slot is installed over the expansion joints. At the other side of the vertical lanes and at the horizontal edges of the permanently installed insulation, the flashing strips are flat. The flashing is fastened in place by nuts screwed on to the threaded stove bolts welded to the anchor plates, mentioned earlier.

The flashing strips serve also to hold the sheet metal covers with which the removable insulation panels are finished. Where the lane is vertical, one edge of the cover slides into the slot in the flashing at one side of the lane. Where the lane is horizontal, one edge of the cover slides under one of the flashings. The other edge of the cover in either case is bolted to its respective flashing.

MARSHALL F. ALLEN is *manager of the Magnesia Insulation Manufacturers Assn., Washington 4, D. C.*



Triple Effect Evaporator



Forced Circulation

Something New In Saltmaking

L. D. SIMMONS

The old-time salt makers said it couldn't be done. If you were producing salt, the only vacuum pans that would give you the right grain size were the calandria pans. They were even borne out by the fact that all of the producers of salt for sale to the food industries were using this type of pan.

Yet, the management of the Michigan Chemical Corp. didn't like the setup. Their powerhouse then was going full-tilt. Extracting salt from the millions of tons under Michigan's terrain was only the beginning. Next they took the bromine out of the brine. Magnesium was there too, and the calcined hydroxide was useful in the rubber, rayon, ink and insulating trades. Even the calcium chloride in the brine was concentrated and sold as a dust palliative. Lastly, a DDT plant was born out of the war effort.

These things put a pretty heavy demand on a power plant and the engineering section tried to keep pace with constant power changes. After a while they found they couldn't keep up, so they said there must be a better way. There was.

The company began intensive studies of the salt evaporators, the largest users of steam. Calculations based on fifteen years' experience and on brine tests showed that good evaporation efficiency could be expected from a set of triple effect evaporators, and that little more could be gained by the installation of additional effects.

The Zarumba Co. of Buffalo designed a set of vacuum pans. The relative merits of the calandria type evaporators and forced circulation evaporators with outside heat exchangers were studied. It appeared that the forced circulation evaporators had the advantage from the standpoint of size of equipment, heat transfer, accessibility for maintenance of exchanger tubes, and more uniform flow through the heat exchangers.

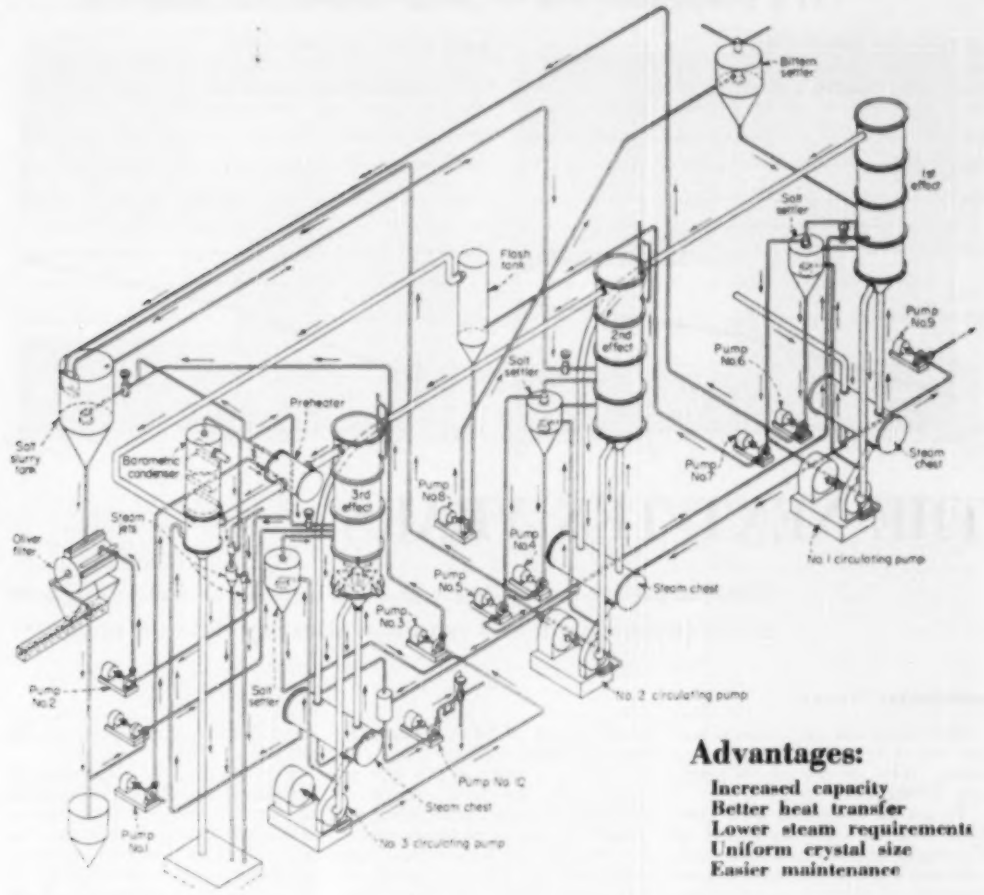
Armed with these facts, pressed by the need for an immediate change, hindered by lack of time for pilot plant work, management decided to take the calculated risk.

Contracts for the construction of a new pan house were let and construction work was started early in 1950. The evaporators were designed, built, and installed. Installation work was sufficiently far along for trial runs by the end of June.

Now, after two month's operation, it has been proved that a satisfactory grain of salt can be produced in forced circulation vacuum pans. Much of the very small grain salt, ("flour") has been eliminated. Screen analyses of the salt have shown that some of the crystals are actually large enough to be retained on a 15 mesh screen. As additional operating data are collected, and as techniques are improved, it may be possible to exercise surprising control over the grain size of the salt produced.

Efficiencies and evaporating rates are being studied very carefully by the production and process sections of Michigan Chemical. Operation at this time indicates that production capacity has been materially increased, and that an appreciable reduction in the steam required per ton of salt has been realized.

L. D. SIMMONS *is vice-president and plant manager of Michigan Chemical Co. Previously he was with Army Ordnance, DuPont, graduated from V.P.I. in 1934.*



Advantages:

Increased capacity
Better heat transfer
Lower steam requirements
Uniform crystal size
Easier maintenance

How It Works

The isometric drawing above indicates the setup of the equipment.

They take brine from the wells and pump it through an interlocking pipe system to storage tanks near the plant. Next, corrosive hydrogen sulphide is removed and manganese is precipitated to avoid pink coloration of the salt.

Then they pump the brine from the storage tanks through a heat exchanger and into the third effect. It circulates from there through the steam chest and back into the vapor body. A portion of the circulating brine is drawn off and passes through the salt settler shown above. Salt is removed in the settler and pumped to the salt slurry tank. From there it runs to the top feed vacuum filter. The overflow from the salt slurry tank holds a considerable amount of dissolved sodium chloride. This brine goes to the second effect pan where it is subjected to further concentration.

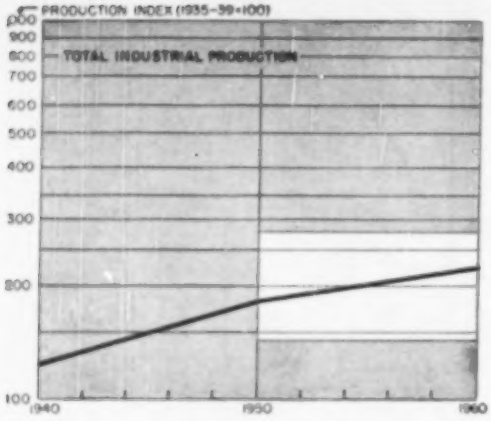
Pumps carry the salt removed in this effect to the salt slurry tank. Brine taken off the top of the salt settler is then fed to the body of the first effect for still more concentration. Again salt is removed and pumped to the salt slurry tank while the remaining bittern is drawn off for further processing to produce the bromine, magnesium hydroxide and calcium chloride.

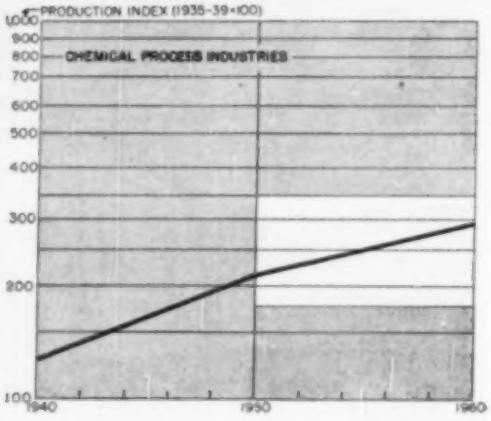
Note that steam exhausting from the turbogenerator is used to supply heat to the steam chest of the first effect pan. Steam produced by the boiling liquor in the first effect body supplies heat for the second effect steam chest, and similarly, the third effect. The condensate from the steam chests goes back to the powerhouse to be used as feed water for the boilers.

The flow of the salt and the brine through the system is designed to constantly "wash" the salt in weaker solution of brine. This produces sodium chloride that's at a maximum degree of purity because the quantities of calcium chloride and magnesium chloride which adhere to the crystals of the salt have been reduced.

This way the company produces salt which more than meets the purity specifications for USP sodium chloride.

CPI is growing faster than our average manufacturing industry as . . .





THE NEXT TEN YEARS

Chemical process industries are growing in peace or war. Long-term growth potentials will help expansion plans pay off in the future.

EDITORIAL STAFF

How much can the chemical process industries grow in the next ten years? What are the growth potentials for the CPI?

To get the answers to these questions McGraw-Hill's Department of Economics sat down and made some estimates which would help the management of chemical process industries firms prepare their long-range plans for the future. These estimates are not forecasts, not firm predictions, not indications of a smooth and well expanded business over the next decade. They are an estimate of what can happen based on our economy's growth in the past.

In the chemical process industries—in fact in any business—one cannot base decisions solely upon the examination of the outlook for six months or a year ahead. Even in the atmosphere of a threatened war, a keen awareness of the longer-term trend is essential. This must always be balanced in our thinking against the short-term swings which have immediate impacts on current volume and profits.

Calculations for this report were based on the asumption that a military procurement program would continue along the proportions we had in the spring of 1950. Then the shooting started in Korea.

However, a study of this type assumes new importance because of these developments. Mobilization will disturb our current economic picture, for how long—it is impossible to judge at this date. But long-term growth factors latent or active, will still be germinating beneath the surface.

Chemical Engineering has translated these estimates into a series of graphs which indicate the actual growth between 1940 and 1950 and the potential normal growth in the next ten years for nine big sections of the chemical process industries.

Synthetic fibers like rayon and nylon along with Orlon and Fiber V are growing at a rate which may double their markets by 1960. New fibers like Orlon or Dynel may well replace wool as nylon did silk. At present, chemical plants are furnishing about 20 percent of our fiber requirements. By 1960 close to 40 percent of the fiber consumed in U. S. Textile mills is likely to be synthetic. Even natural fibers are going to get a wider chemical treatment to prevent shrinkage or wrinkling.

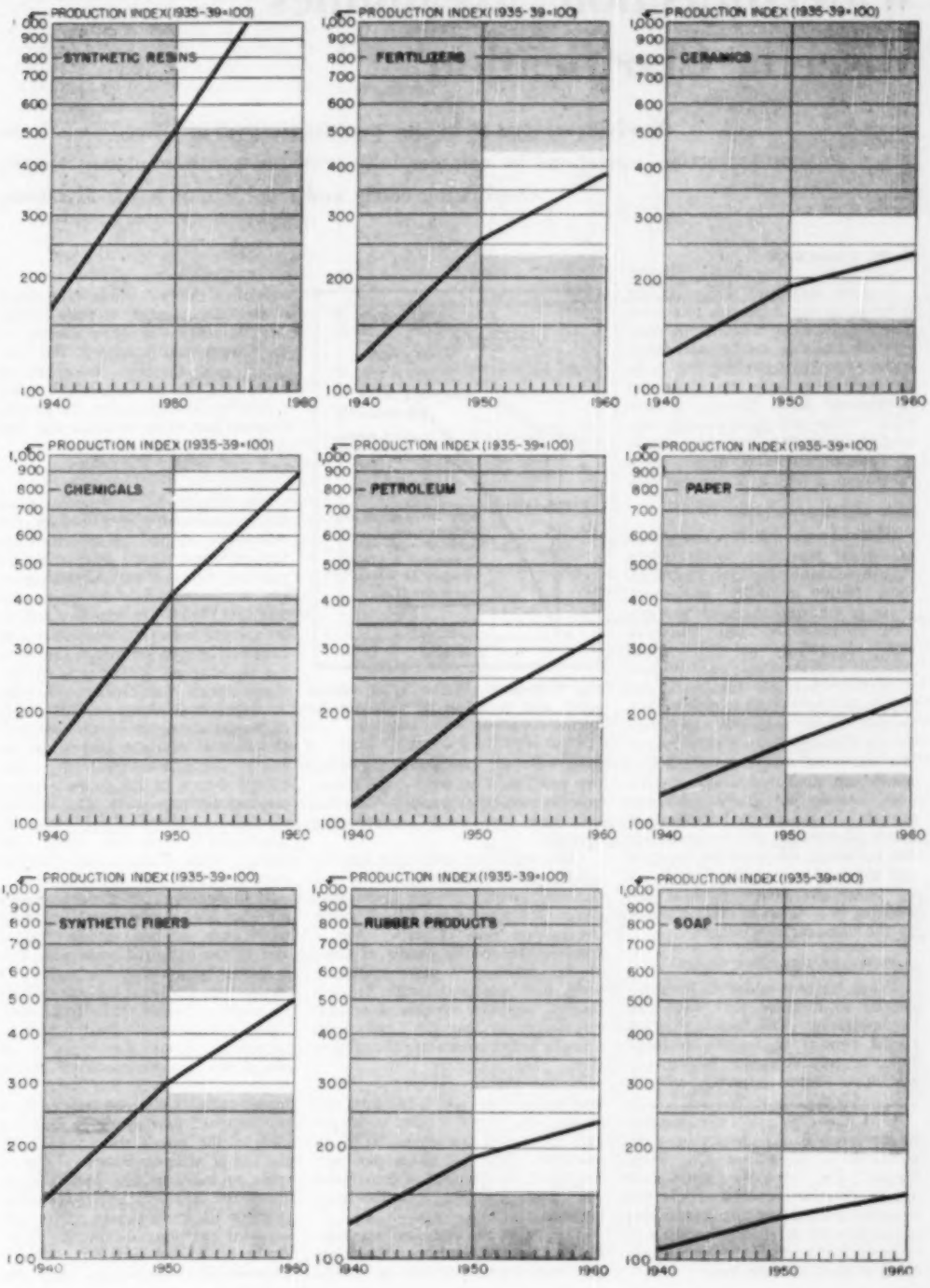
Plastic materials are finding wider applications every day. Production should total close to 3 billion pounds per year by 1960.

Petrochemicals are glamorizing the petroleum business. A swelling stream of chemicals will come from refineries as the oil firms go further into this field. By 1960 about 40 percent of all synthetic organic chemicals will be made from oil and natural gas. Today the ratio is about 25 percent oil and 75 percent coal. Production of conventional refinery products will also rise sharply.

Medicinals will be used in even larger quantities. Doctors will prescribe for more people in 1960 than ever before as both industry and government are increasing medical aid programs. Antibiotics have reached the biggest headlines. However, other medicinal chemicals are also growing in stature.

Chemicals for the farm have offset the higher cost of farm labor and the gradual depletion of the soil. Fertilizers, insecticides, and wheat storage will be needed to raise crop yields per acre. There is a rising demand for new drugs to stimulate growth and reduce disease among livestock. Total consumption of chemicals in agriculture will be up a third or more if these trends continue until 1960.

. . . These process industries are helping in the upward push



Water-Injection Streamlines Miscella Clarification

Newly-developed technique permits removal of oilseed fines from solvent extraction operations in commercially-available continuous centrifuges, eliminating costly and troublesome batch filtration.

J. M. CROCKIN

A newly developed water-injection technique makes it possible to remove oilseed fines from miscellas in commercially-available continuous centrifuges. Installations using this technique do away with the costly and troublesome batch filtering of miscella. They run approximately two weeks between cleanings with virtually no operator attention, despite feeds containing as high as 1 percent fines.

WHY WATER-INJECTION?

Without water-injection, continuous centrifugal separation would require a machine combining high centrifugal force (6,000 × gravity or better), ability to discharge the solids and miscella continuously, and reasonable cost. Apparently no commercially available centrifuge combines all these properties. Available high-speed machines do a fair job of clarification but, because of the nature of the solids, do not discharge them readily. Available machines designed with helical screws can discharge solids continuously but do not develop sufficient centrifugal force for good clarification. Batch centrifugals are unsatisfactory due to limited solids-holding capacity, and the tendency of the fines to set up under the action of heat and moisture to a mass not easily removed by the dumping mechanism.

HOW WATER-INJECTION WORKS

When water is added to fines suspended in miscella, they swell and become slimy. The fluidity thus imparted permits continuous discharge from several available, high-gravity machines. Since extracting solvents in use today are immiscible with water, the problem is to reduce the water-miscella interfacial tension. This can be done by using surface-active agents.

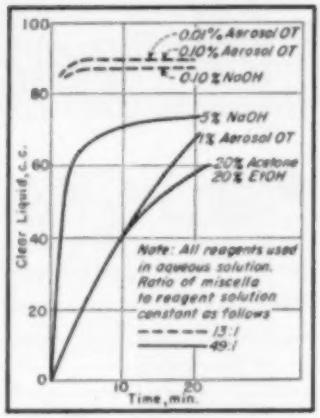


Fig. 1—Relative effectiveness of various agents used to reduce the water-miscella interfacial tension.

Once water has penetrated into the solid particles they swell visibly, and the effectiveness of the agent used can be followed by the rate at which the swollen particles settle. Fig. 1 presents the relative results of some of the agents used on a laboratory scale, with gravity settling. In each case the aqueous solution of reagent was shaken by hand for 2 min. with miscella before measuring the settling rate.

If the quantity of wetting water used exceeds that which the fines will absorb, viz., about 4 parts water per part dry solids, the excess forms an emulsion. The free water, plus wetting agent and dissolved protein, forms one phase and the miscella forms another.

Trapped in the emulsion is a quantity of fines. In plant operation it has not been found practical to control accurately the water-fines ratio since neither the quantity of fines in the miscella nor the moisture content of the fines remain constant. The centrifuge must therefore be capable of discharging this emulsion, which forms a third phase intermediate in density between that of the miscella and that of the wetted fines, or sludge.

COMMERCIAL INSTALLATIONS

The simplified flow diagrams show two commercial applications of the centrifugal method of miscella clarification, based on the water injection process. In each the miscella quantity is approximately 30 gpm. containing 0.15 to 0.3 percent fines. Both centrifuges have vertical shifts. The fixed-nozzle type centrifuge shown in the top diagram utilizes separate discharge ports for clarified miscella, emulsion, and sludge. The sludge discharges continuously through nozzles located near the bottom of the bowl. The automatic valve type centrifuge shown in the lower diagram uses two discharge ports. One handles clarified miscella and the other, an automatically operated valve, discharges both sludge and emulsion from the lower part of the bowl.

It is necessary to choose nozzles for the fixed-nozzle type centrifuge which are not too readily plugged and to use sufficient nozzles so that if one or two do plug the bowl is not thrown too badly off-balance. With six nozzles of approximatetly 1.0 mm. diam., a capacity of about 6 gpm. is obtained. Since the quantity of sludge and emulsion combined do not begin to approach this value, the nozzle capacity must be satisfied by a supplemental flow, either by recycling part of the nozzle discharge, or by the use of make-up water. If the recycle or make-up flow just balances the nozzle capacity, the two interfaces between the three phases will occupy constant positions within the bowl. An excess flow of recycle or make-up automatically discharges from the

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emulsion port, so that by maintaining a slight emulsion discharge flow maintenance of the interfacial positions is assured. A shortage of recycle or make-up flow results in breaking of the aqueous seal around the nozzles, and miscella will discharge from these openings.

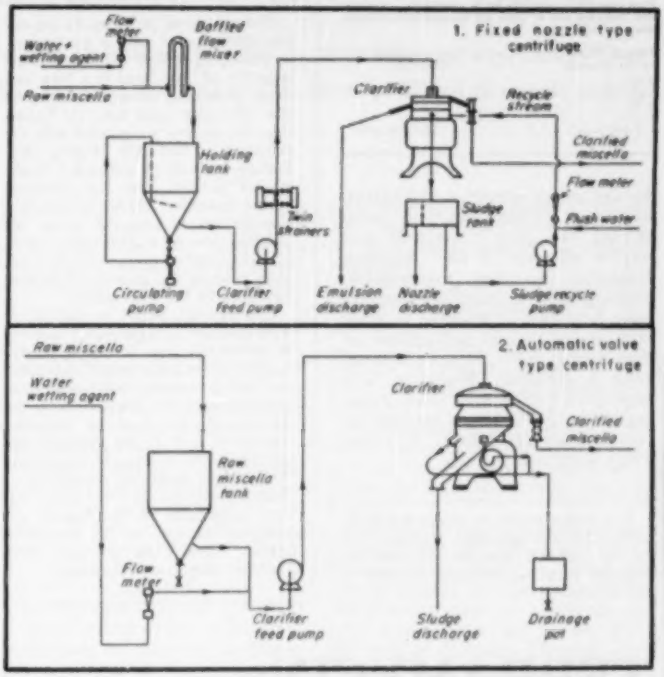
In the case of the automatic valve type centrifuge, the valve opens periodically when the emulsion reaches a predetermined maximum depth in the bowl, and closes when the layer falls below a predetermined minimum depth.

The two systems described above have been in service for over a year. One of these systems is installed at the Abilene, Tex., plant of the Clayton-Anderson Co., the other at the Cleveland plant of the Sherwin-Williams Co.

Typical operating data for both systems are given in Table I.

It would be hazardous to comment on the relative merits of the two types of centrifuges, because they are not operating on the same feed material. The wetting agent must be used carefully if the presence of excessive emulsions is to be avoided. On the other hand, longer operation may be expected between cleanings if wetting agent is used. The emulsion is rather easily broken, so that no oil loss need be suffered.

Two Methods for Continuous Clarification of Miscella



BATCH FILTRATION

The use of filters for miscella clarification has proved highly satisfactory where the fines in the miscella are very low in quantity. However, where the fines in the miscella are in the order of 0.1 percent or greater, the use of batch filters may become difficult to the point of being economically prohibitive.

Oilseed fines are difficult to filter because they are colloidal in size and frequently sticky. Within reasonable ranges of presure drop the filter surface requirements rise rapidly as the fines content of the miscella increases. The figures given in Table II indicate a rough relation between these factors.

The operating labor assigned to that portion of solvent-extraction plants

Table I—Typical Operating Data for Centrifugal Miscella Clarification, Using Water Injection

Stream	Solvent	Wetting Agent	Oil	Oil, %	Solv., %	Solids, %	Water, %	Oil, Lb./Hr.	Solv., Lb./Hr.	Solids, Lb./Hr.	Water, Lb./Hr.
Fixed-nozzle centrifuge runs											
Clarifier feed	Heptane	Aerosol OT	Linseed	13	85.6	0.103	2.3	1003	7380	8.3	166
Flush water							100				1000
Recycle stream				0.024	1.5	0.28	98.2	0.96	60.25	11.3	3930
Emulsion				1.02	6	2.5	90.5	1.8	10.6	4.4	139
Nozzle discharge				0.03	2	0.38	97.6	0.24	31.3	4.0	1036
Clarified miscella				12	87.9	0.001	----	989	7227	0.08	tr.
Clarifier feed	Hexane	Aerosol OT	Linseed	22.8	75.2	0.31	1.7	2060	6800	28	153
Flush water							100				2724
Recycle stream				0.04	0.63	0.16	99.2	2.1	36.1	9.3	5679
Emulsion				1.39	4.50	1.16	93	24.8	86.6	22.3	1789
Nozzle discharge				0.07	1.20	0.31	98.4	0.77	13.2	3.4	1084
Clarified miscella				23.2	76.8	0.03	0.02	2084	6700	2.6	1.7
Clarifier feed	Hexane	Aerosol OT	Linseed	20	79.35	0.13	0.64	2413	9653	14.5	76.6
Flush water							100				3767
Recycle stream				0.13	0.23	0.17	99.6	0.9	15.6	11.7	6740
Emulsion				0.60	1.10	0.19	98.1	0.3	17.1	3.0	1526
Nozzle discharge				0.03	0.52	0.30	99.1	0.7	13.2	9.1	2318
Clarified miscella				20.1	79.9	0.02	----	2403	9934	2.4	tr.
Clarifier feed	Hexane	None	Linseed	17.0	82.8	0.3	----	1668	8115	17.6	tr.
Flush water							100				3216
Recycle stream				0.04	0.60	0.32	99.1	2.2	37.1	19.8	6158
Emulsion				tr.	0.05	0.35	99.6	----	0.8	5.7	1676
Nozzle discharge				0.07	1.34	0.66	98.0	1.2	20.6	11.0	1624
Clarified miscella				17.1	82.9	----	----	1667	8094	0.0	tr.
Automatic valve centrifuge run											
Clarifier feed	Hexane	None	Cottonseed	10.9	82.7	0.36	----	2180	10074	46	----
Water							100				479.5
Nozzle discharge				1.68	8.36	60	----	8.98	----	44.5	479.5
Clarified miscella				10.9	83.1	----	----	2171	10074	----	----

Table II—Filter Performance

Flow rate—1/3 gpm. per sq. ft. filter area. Operation includes use of filter aid precoat and periodic filter aid addition.

Percent Fines in the Miscella	Approximate Filter Life
0.001	2 weeks
0.05	10 hr.
0.25	6 hr.
0.80	3 hr.
1.0 and over	Virtually zero

devoted to the extraction, distillation, and desolventizing operations rarely exceeds two men. Frequent and lengthy attention to filter operation (including precoating, cake-washing, cleaning, and re-assembly) requires more time than is available to these men in addition to performance of their normal duties, so that additional labor is required. Moreover, with large quantities of filter cake, steaming of the filters before opening (to eliminate solvent hazard) is a very messy operation.

The author wishes to express his appreciation for the assistance accorded him by the DeLaval Separator Co. and the Sharples Corp. in reviewing the text of this article.

Fines in Distillation System = Frequent Shutdowns

Common to all processes for the solvent extraction of oilseeds are five major process operations: (1) Preparation—reduction of the oilseed to a form and shape permitting extraction of the oil at a reasonably rapid rate. (2) Extraction—the oil seed is contacted with the extracting solvent. (3) Miscella clarification—removal of suspended finely-divided particles from the oil-solvent extract (miscella). (4) Miscella distillation—solvent is recovered from the miscella, leaving a solvent-free crude oil. (5) Desolventizing—virtually complete removal and recovery of solvent remaining on the solid residue.

The oil-laden extract, or miscella, always contains in suspension a quantity of micron-size fines in varying proportions to the miscella weight, depending on (1) the nature and method of preparation of the material being extracted, (2) the type of extracting equipment, and (3) the conditions under which the equipment is operated. These fines must be moved, or at least reduced to a very low figure, else they accumulate on the heating and stripping surfaces in the distillation system where their presence causes frequent shut-downs for cleaning.

Of the two types of extraction equipment, the percolation-type is better by far from the fines standpoint. This is because solvent trickles through a bed of solids which functions as a filter. The miscella contains a very small quantity of fines—in the order of 0.001 percent.

The various types of immersion extraction equipment now in use have in common the fact that the final separation results in carryover of a considerable quantity of fines into the miscella, perhaps from 0.1 to 5 percent. In immersion-type extraction equipment the oilseed is suspended in, mixed with, settled or dragged through a body of extracting solvent. Whereas flaked or granulated materials can be extracted in either percolation or immersion-type equipment, those materials which cannot be formed into flakes or granules must be handled in immersion-type equipment. There remains the alternative of forming such materials into a press-cake which can subsequently be broken up and flaked. The choice between this process and those using immersion-type extraction equipment without pre-pressing is one of economics.

TERRAMYCIN

A case history in the rapid development of a new antibotic

In the summer of 1949, the new mold, *Streptomyces rimosus* was isolated by one of the bio-research teams at Chas. Pfizer & Co., Inc. In March 1950, the crystalline hydrochloride salt of Terramycin was on the market. It was being evaluated through one of the broadest clinical programs ever instituted for the final testing of a new antibiotic.

In a period of months, Pfizer, through a highly coordinated research team, has accomplished a feat which took fifteen years in the case of penicillin and three years in the case of streptomycin.

Here is how Pfizer tackled this problem: The origin of the new mold was in the mycological laboratories of Pfizer's biochemical research and development division. Its staff isolated and screened over 100,000 soil samples in their search for suitable molds. As soon as their preliminary studies were completed, and the new antibiotic was recognized as having unusual antibacterial activity, the development program got underway. Meanwhile, this original group of mycologists continued their efforts to produce new strains of the mold which would yield this antibiotic at lower cost.

The new antimicrobial material was subjected to preliminary screening tests under one group of bacteriologists to determine *in vitro* activity. Another group of bacteriologists tested the drug's effectiveness against a wide variety of pathogenic organisms *in vivo*. Simultaneously, a group of virologists study the effectiveness of the drug against a variety of viruses and rickettsial organisms.

Following the early screening, trained groups of pharmacologists stepped in, testing fully the pharmacological behavior of the new agent. Comprehensive tests were run to determine the dosage levels which animals will safely tolerate, as well as on the type of toxicity manifested by very high dosages.

Since the early stages of isolation, a group of chemists and chemical engineers in the chemical research department worked on methods for the separation, purification and the ultimate goal—crystallization of Terramycin. Unlike many other antibiotics in their early stage, Terramycin was successfully crystallized at an early date. This avoided the possibility of unfavorable clinical results due to the presence of impurities.

Following successful crystallization, Terramycin was studied further by a group of chemists in the analytical department. They determine the composition as well as the physical and chemical characteristics. This data aids the chemical research group in their work on structure and synthesis.

The work of the chemical research group on recovery problems was taken up by chemical engineers in the development group and placed on a pilot plant basis. From here production chemical engineers carried it into the intricacies of commercial production using submerged fermentation.

As John E. McKeen, Pfizer's president points out the field of antibiotic research and development is one of the new frontiers of science. In the past year his firm alone developed Terramycin, Viomycin, Netropsin, and Thiolutin. A few years ago this would have been inconceivable.

German Chemicals Are Coming Back

A revitalized chemical industry is searching for markets. What impact will it have on your exports? Here is where it stands today.

JOHN J. CHRISTIE

West German chemical industry is compensating for dislocations caused by the "iron curtain." It is converting prohibited productive capacity into useful service.

Most new capacity installed in western Germany postwar has been to fill gaps caused by the "iron curtain." And, the same goes for most of the research and development activity initiated since the war.

Making up for the large-scale, wide-range production of the former I. G. Farben plant at Wolfen, now a Soviet AG, has been a big job.

West Germany had to build up its production of full synthetic fibers from scratch. Prewar development centered around Wolfen. All synthetic fiber output came from this and other plants in the east.

Volume production of perlon was initiated at the former I. G. Farben plant at Bobingen in Bavaria, which supplied a spinning plant at Obenburg for an output of 100 tons of fiber per month. This capacity is being enlarged.

Meanwhile, a larger new producing unit recently began operations within the so-called Leverkusen group of former I. G. Farben plants, with Urdingen producing the material and Dormagen doing the spinning.

Pilot plant production of PC fiber, another Wolfen specialty, has begun at Ludwigshafen-Oppau in the French zone. Facilities for full scale production are expected to be completed before 1952.

The west German chemical industry is making a strong bid to advance acrylonitrile. Leading technicians from the development center at Wolfen fortunately managed to flee the Soviet zone and are working at the Cassela plant outside Frankfurt/Main. A large scale lab to be devoted primarily to polyacrylonitrile, for which an ERP counterpart fund credit of 600,000 DM was granted, will be completed by the end of this year.

Ludwigshafen also is working on it in the lab stage, and will build a new plant for production of polyacrylonitrile. The new installation, with a capacity of 200 tons per month, is scheduled to be completed in March 1951.

A Wolfen series of fur dyestuffs is now manufactured by Leverkusen and Hoechst. Meanwhile, Offenbach developed the new Rauna process for fur dyes using naphthol dyestuffs. Ludwigshafen also has developed new products in this field.

Leverkusen has built new capacity for production of photographic chemicals and film base, formerly an important Wolfen line. Film coating presently is being done in Leverkusen's photographic paper plant but soon will have separate facilities.

As compensation for the 1,000 tons per month output of fine quality PVC powder from the former I. G. Farben plant at Bitterfeld, Ludwigshafen is now producing 500 tons per month and another 500 tons is coming from the converted buna plant at Huls.

Western Germany as yet has no phosphorus production. But, Leverkusen has begun manufacture of phosphorus compounds, PCl_3, $POCl_3$, $PSCl_3$, as well as triphenyl phosphate. This production compensates for phosphor products formerly supplied by Piesteritz.

New facilities have been built at Leverkusen for production of certain types of ion exchangers, which formerly were made exclusively at Wolfen.

MORE PLASTICS

Ludwigshafen is stepping up development of plastics materials, and will increase output of such items as urea, polystyrene and formaldehyde.

The new research lab at Cassella, aside from working on polyacrylonitrile, will carry forward previous German development work in melamine. Due to the patent situation, the Germans couldn't export this product except under special conditions before 1953. Meantime, they will be preparing for regular production.

Considerable capacity has had to be installed in western Germany since the war for producing mersol, basis of Germans detergents. Some five plants have new facilities. Leverkusen also has increased its capacity for making liquid SO_3.

Expansion of fertilizer production was given highest priority by the occupying powers because of the critical need for improving the condition of German agriculture. Export of fertilizer was prohibited until February, this year.

But, although exports are now permitted, agricultural experts are trying to boost domestic use, which is still below the level of most of western Europe.

Hoechst last year completed a plant for production of Nitrochalk. (Production of pure ammonium nitrate is now prohibited in Germany). The new Hoechst plant has a capacity of 2,000 tons of pure nitrogen and 10,000 tons of fertilizer. Hoechst also has been given Allied permission to work on development of a Nitrophoska plant.

SYNTHETIC FUEL UNITS

Western Germany's synthetic oil and rubber plants were removed from the reparations list by terms of the Bonn Protocol last November. This agreement between the Allied High Commission and west German government virtually ended the reparations program and relaxed certain other restrictions on industry.

Prohibition against manufacture of synthetic gas and rubber, however, was not lifted. Instead the Germans were given opportunity to make proposals for utilizing these plants for other processes acceptable to the Allied Military Security Board.

Two of western Germany's four Bergius plants already are converted to hydrogenation of oil residues. And, it appears likely that permission for the other two to operate likewise will be granted.

The Bergius plants can play a useful role in the west German petroleum industry in the next few years. There is a woeful lack of cracking capacity. Germans failed to develop a large-scale cracking industry due to their preference for coal hydrogenation.

Two factors favor maximum use of

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the Bergius plants, pending completion over the next several years of a program for installation of new cracking capacity. These are: (1) There has been a notable postwar exploitation of the Emsland oil fields near the Dutch border, and (2) foreign exchange considerations require that the new republic confine its import requirements to crude oil as far as possible.

German crude oil production from the Emsland fields amounted to only 445,000 metric tons in 1936. The occupying powers were responsible for pushing postwar exploration and considerable drilling equipment was brought in from the U. S. By 1948, output was up to 635,700 metric tons and in 1949 to 845,000. It is expected to pass a million this year and eventually reach about 2 million tons. Emsland crude is poor in grade, having 65 percent residues.

TWO BERGIUS PLANTS

The two Bergius plants now in operation are: Gelsemberg Benzin AG of Gelsenkirchen, built originally for hydrogenation of unsalable grades of hard coal, and Union Rheinische Braunkohlen-Kraftstoff AG of Wesseling, which originally was based on brown coal.

Gelsenkirchen and Wesseling are processing oil residues at the rate of 500,000 tons per year, using both domestic and imported crude. And, this capacity could be increased even further.

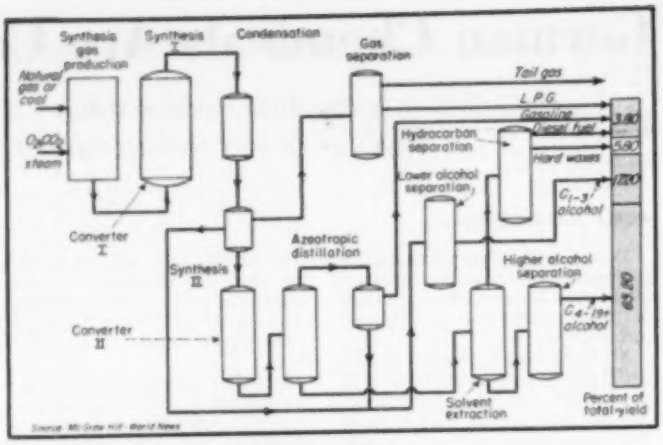
The other two plants, now idle pending Allied Security Board decision, are: Hydrierwerk Scholven AG at Gelsenkirchen-Buer, originally based on hard coal like its sister plant, and Ruhroel GmbH at Bottrop, which formerly operated on the basis of coal tar pitch.

It is reported that all four plants, if fully rehabilitated, could process up to 1.4 million tons of oil residues per year.

The Gelsenkirchen and Wesseling plants are producing a 70 octane gasoline. Although a more costly process, hydrogenation has certain other advantages from a German standpoint, aside from pinch hitting for cracking capacity:

The hydrogenation plants produce no second-class materials like fuel oil or coke; the former has little or no market in Germany and the latter is unnecessary. The Germans also point out that the hydrogenation process permits greater exploitation of the end products.

Cost of hydrogenation is said to be 130 DM per ton, as against 80 DM per ton for cracking. This can be lowered somewhat simply by increasing the throughput. Furthermore, the differential is open to question because of heavy rehabilitation charges which apparently have been figured in operating costs.



West Germany's oxyl process yields higher alcohols.

The hydrogenation plants can become a more economic proposition by installation of cracking facilities, which would reduce costs and increase throughput. This involves a three-phase process: (1) topping or primary distillation, (2) cracking to a fuel, and (3) hydrogenation of bottoms from cracking. Losses from topping to hydrogenation are said to be 17 percent, whereas with three-phase operation they would be 8 or 9 percent.

MORE CRACKING UNITS

Now up for final approval is a proposal to install 420,000 tons per year cracking capacity at Wesseling, requiring expenditure of 10 million DM and $200,000. This will not be done at Gelsenkirchen because of its proximity to the Emsland fields. Instead it is planned to build a large cracking installation adjacent to the Emsland at Lingen.

The Lingen project, also up for final perusal, would consist of topping and cracking facilities specially designed for the processing of Emsland crude. It would have a topping capacity of 600,000 tons per year and cracking capacity of 360,000 tons per year. Estimated cost is 36 million DM, of which 24 million DM is requested from ERP counterpart funds, plus an outlay of $450,000.

Allied expert and OEEC Oil Committee, making separate studies, have estimated that western Germany will require a crude throughput of 4.8 million tons per year in 1953. To obtain necessary product distribution to meet requirements of the German market, the installation of 1.5 million tons per year of cracking capacity is needed in addition to rehabilitation of existing facilities.

FISER-TROPSCH PLANTS

Western Germany's six Fischer-Tropsch plants also were removed from the reparations list. The prohibition against their use for production of synthetic fuels as primary product stands. But, they can be utilized for other processes acceptable to the Allied Military Security Board.

Already under way is the conversion of the Krupp Treibstoffwerk at Wanne-Eickel to the oxyl process. Work is being done by Lurgi in collaboration with Ruhrchemie AG and is scheduled for completion in the spring of 1951. It will have an output of 30,000 tons of alcohols per year.

The oxyl synthesis (not to be confused with the oxo process) is applied mainly for the purpose of obtaining, apart from hydrocarbons, alcohols with higher molecular weight containing 2 to 40 carbon atoms. Alcohols and neutral oils are worked up and separated by a simple method. It is possible to supply the chemical industry with primary alcohols with a purity degree of 95 to 98 percent, which are either directly used as solvent or softener or further processed into detergents. The purity of the alcohols also offers the possibility of supplying the chemical and pharmaceutical industry with valuable raw materials.

Basic materials used in the process are carbon monoxide, derived from coal, and hydrogen. These are used as water gases but in proportions different from those used in the Fischer-Tropsch synthesis. Two catalysts are used: (1) a ferrous based catalyst in

the gaseous reaction phase, and (2) a cobalt-based catalyst in the liquid reaction phase.

The final byproducts of the process include approximately 17 percent gasoline, oils and lubricants, although at an intermediate stage there exists some 30 percent of these products. It has been recognized, however, that the final percentage of byproducts is comparable to the percentage of the byproducts found in many chemical reactions.

Now pending before the Military Security Board is a proposal for converting the Bergkamen plant of Essener Steinkohlen AG to production of gas for normal heating purposes by hyper purification and elimination of the toxic properties of coke oven gases. This process, according to German experts, also involves production of only small quantities of gasoline, oils, lubricants and sulphur. The Bergkamen plant, which as a Fischer-Tropsch installation had an annual capacity of about 85,000 tons of primary products, was badly damaged but has been reconstructed to a large extent since the war.

Proposals for conversion or disposition of the other four Fischer-Tropsch plants have not yet been announced. The other plants are: Ruhrchemie AG at Oberhausen Holten, original capacity of 65,000 tons per year, which suffered heavy destruction; Steinkohlenbergwerk Rhein Preussen at Moers, 73,000 tons annual capacity, which was partly damaged; Dortmunder Paraffin Werke of Dortmund, about 50,000 tons capacity, which was not badly damaged; Gewerkschaft Viktor at Castro-Rauxel, 61,000 tons annual capacity, which plant together with Krupp Treibstoffwerk had Allied permission to operate on the Fischer-Tropsch process for a monthly output of 5,000 tons until Dec. 31, 1949, as a temporary means of bolstering fuel supply pending improvement in the import situation.

RUBBER PLANS

The west German government is considering asking Allied approval for reactivation of buna rubber production at the Huls plant in the Ruhr. This, of course, would require a further revision of the prohibited industries list.

Facilities at Huls are being utilized for production of solvents, detergents and polyvinyl chloride. German government experts report that change back to buna production utilizing one unit, which would give a monthly output of 600 tons, could be accomplished in three months. Within five months a second unit could be operating for an output of 1,200 tons. Potential capacity is 3,600 tons per month.

Permission to re-activate Huls buna production would have been out of the question only a few months ago. But, now that western Germany is figuring prominently in western European security calculations, such a request likely would receive sympathetic consideration at the council tables.

Aside from the long-range possibility of being cut off from natural rubber supplies, there is the immediate concern over the price of natural rubber in western Germany which has risen from 1.60 DM per kilo in January to 5 DM.

Revival of buna production will be sought only for the Huls plant. Leverkusen's remaining perbunan capacity, after some reparations removals, is being devoted to a number of products, including mersolates, dyestuff intermediates, tanning auxiliaries and chemicals for a new textile printing process, known as Acrymin.

Only other buna capacity in western Germany was at Ludwigshafen but this was largely removed by war damage and reparations. Remaining equipment has been turned to other uses.

SOME CHEMICAL GAINS

The west German chemical industry has registered big gains in both production and exports, particularly since the turn of this year. Still, its comeback isn't quite as dramatic as the statistics imply.

The over-all chemical production index has been averaging about 110 percent of 1936 and has reached as high as 114 percent. But, in the case of the chemical industries, 1936 is a poor standard index year because of the notable expansion which took place from then until 1943. There was considerable war damage after 1943 but most of this has been repaired and present capacity is well above 1936.

Production of basic chemicals during the first half of 1950 thus was running like this: sulphuric acid, 103; soda ash, 154; chlorine, 208; caustic soda, 227, and carbide, 125 percent.

Monthly chemical exports for the last quarter of 1949 averaged $8,468,000 while the first half of this year they averaged $14,933,666. The gain is encouraging but the goal is some way off. For, volumewise, exports are about half the prewar rate.

Chemical exports were Germany's biggest foreign exchange earner prewar. Their ratio of the total exports was approximately 15 percent: 60-65 percent of these exports went to European markets and the rest overseas, mainly to the Americas and Asia. Of the European exports 25 to 30 percent, or about 20 percent of the total chemical exports went to countries now behind the "iron curtain."

Last years chemical exports of $95 million accounted for about 8.5 percent of west Germany's total export trade. In the first quarter of 1950, their value was $43.8 million or 12.3 percent of total exports. Following the general trend of west Germany's export trade, about 80 percent of last year's chemical exports went to European countries: 65 percent to western and 15 percent to eastern.

The Germans have suffered a loss in dyestuff markets, as after the first World War. This is reflected in the fact that production is only about 50 percent of the 1936 level.

German producers don't expect to regain their pre-war position entirely, if for no other reason than the considerable worldwide increase in capacity. Present political conditions are hampering exports still further, particularly in respect to eastern Europe and China.

Still, German producers contend prospects are good for regaining some of the markets temporarily lost chiefly to the Swiss and to the British. They base their hopes on the still strong tradition for German products in certain world markets, notably South America.

I.G.'S BREAKUP

The deconcentration of the I. G. Farben cartel has made marketing more difficult than prewar. Each of the new enterprises created out of the old combine is required to maintain its own sales outlets. This, of course, means a limited range of products available from any one German producer. However, final decisions governing the former I. G. Farben units haven't been taken and it is likely that provision will be made for more liberal marketing arrangements.

Production of pharmaceuticals is now back to the 1936 level but just last fall it was only 55 percent. Subnormal domestic demand was largely responsible in this case. For, prior to the currency reform of mid-1948, German pharmacists took advantage of the abundance of cheap money to acquire huge stocks. It took them from June 1948 until recently to unload the large inventories.

Meantime, pharmaceutical exports have been increasing. This can be attributed in large part to progress in clearing up technicalities and legalities over German trademarks seized during the war.

Editorial Viewpoints

Business Worries

Our contemporary, *Business Week*, occasionally asks its readers "What, if anything, is keeping you awake at night?" The answers over the years form an interesting pattern. Back in 1948 business men worried most about an incipient depression. A correction for the postwar boom seemed long overdue. It came in 1949 and everybody worried about where it was going to stop. But it did and early in 1950 most business men and their economists predicted that volume would be good through June, but that there would probably be a sharp decline following in the second half of this year. That didn't come, of course, but it is now apparent that in each of the last three years we have had a different kind of worry about the volume of business.

What's the present headache? The newest worry is over what Wall Street calls "the peace scare." It's the fear that a damper will be put on defense spending following the Korean successes and this will precipitate a recession in volume. Chemical manufacturers have plenty of worries these days but they are not in the field of general volume. Rather they are concerned with fluctuations and uncertainties that affect pricing and profits, such as rising costs for raw materials, wages and taxes. And chemical business men would sleep a lot better if the government quit changing the rules of the game on allocation and controls and permitted a balanced flow of chemicals to essential industries.

Costly But Necessary Research

Preliminary studies by the Delaney committee of the House of Representatives are furnishing ample proof of the seriousness of the problem of developing chemicals for food and agricultural uses. They furnish also a warning and apparently a guide for chemical industry which deserves thoughtful consideration. We refer particularly to the evidence of the very high costs involved in a final demonstration that a new chemical proposed for these uses is properly so offered.

One distinguished executive of a chemical enterprise has estimated for us that it costs between $50,000 and $100,000 to carry a single chemical through the complete series of studies which are necessary to prove that it is both effective and safe to be placed in the hands of the general public for such usage.

Not the least item of cost comes from the need for elaborate biological studies regarding the effects on animals and plants, the disposal of residues, the elimination from marketed agricultural commodities, and the possible effect on those who use the chemical or may be exposed to it at any later stage from the farmer's field through to the dinner table and the baby's formula supplements.

The extra costs so incurred are going to discourage some small companies and may slow down the development work of even the largest and best equipped. We do not pretend to know how the high costs which are sometimes encountered can safely be cut back. But we are sure that there is urgent and continuing need for more discriminating analysis at all stages of each development program, lest some loophole be left for improper chemical exposure of our employees, our customers' employees, and the general public.

The problem is a responsibility of chemical management. Its magnitude and difficulty will tax our patience and strain our pocketbooks. But it can not and must not be evaded.

Why Spend These Millions?

Modern research has become enormously expensive. In dedicating the great new home of the General Electric Research Laboratory at the Knolls, on October 8, President Charles E. Wilson observed that "the cost of research has gone right through the roof. And it must be paid for in large part out of ordinary man's pants pockets." Therefore it would seem that all of us as citizens and taxpayers, if not as stockholders, have a selfish interest in the accounting of our research expenditures.

An organization such as General Electric has no other choice than to continue to carry on research. It is a sort of life insurance policy in which the company must invest to make sure it has a future. That is where the G.E. laboratory started exactly fifty years ago under the direction of Dr. Willis R. Whitney. But now its dynamic force has spread to affect both the security and economic stability of the country. To return to Mr. Wilson's apt figure of speech, "the life insurance policy today has come to protect a great deal more than the future of any single business or industry. It protects the nation, in war and in peace, by the ultimate provision of powerful defenses and weapons, and by supplying a new store of scientific facts to be rapidly translated into a more efficient, productive and fruitful economy."

There are some who will argue that for this reason more and more of the research "insurance premium" should be paid by the government—and ultimately by us all as taxpayers. They question whether manage-

ment, as a trustee for the rights of employees and stockholders, has the right to spend millions for research programs of admitted importance to the general public, if in so doing such expenditure would jeopardize the earnings and stability of the company.

Fortunately for this country, Mr. Wilson and his predecessors have never dodged this question. They have long realized that their company has social and economic obligations far beyond the primary reason for its existence. They have invested an increasing proportion of G.E.'s research dollars in fundamental science. They have directed their vast technological resources in the solution of problems that affect the lives and security of all of us. And by providing the new buildings and marvelous equipment of a great research center such as the Knolls, they have multiplied by many times the effectiveness and productivity of their scientific manpower.

Draft Problems—Present and Future

It is easy to demonstrate, at least to our own satisfaction, that a chemical engineer is more important to society when applying his technical skills in industry than in most of the combatant and services activities of the armed forces. We suspect that the medical, legal and perhaps other professions also think that their members are of greater usefulness at home than in uniform. Let's keep these facts in mind as we try to make a realistic appraisal of the political aspects of the draft problem.

In the first place, it is evident, as it was during most of World War II, that General Hershey still dominates policy making under the National Selective Service Law. Nor should there be any doubt in our minds about his attitude toward any blanket deferment of technical men. Last month, in characteristic and picturesque language, he told the Society for Personnel Administration that the American public was being sold "a lot of boloney" about scientists and engineers. And as far as we can observe, that opinion has not been changed by equally sarcastic rejoiners that have placed Vannevar Bush and John R. Steelman in the roles of boloney salesmen!

What is needed most is an immediate critical analysis of the present and prospective requirements for technical manpower in the defense program. This must include the needs not only of the armed forces but also of the industries that directly serve the defense establishments and those that serve the essential civilian economy. A parallel survey of scientific and engineering personnel, as has been requested by the Manpower Office of the National Security Resources Board, must also be completed as quickly and as thoroughly as possible. Only when these basic facts of supply and demand are available, will we be in a position to recommend a program for the most effective use of our technological resources.

Meanwhile we should not be put into the position of seeming to ask for special concessions that are not in the public interest. Rather we must work for a procedure that will ultimately assure to the nation the best possible use of scientific and engineering skills wherever employed. This problem becomes increasingly urgent and important as the draft begins to dig deeper into the age groups above 25. Here are many of the key men whose loss to essential industries could seriously cripple the defense effort.

More Basic Research, Better Teachers

National Science Foundation is to be organized under the new public law which was signed by the President last May. That agency's program and resources are urgently needed to replenish our fund of basic scientific facts. Wisely planned, its work can be of tremendous benefit both to the general public and to industry.

Chemical industry can greatly assist the foundation in rendering this important basic service, for we well know the difference between the thing which the foundation should do and the other things which are the functions of industry itself. We should exert our influence to insure the proper planning.

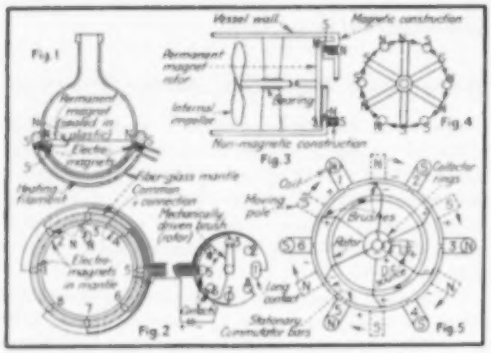
The foundation, by law, will not establish laboratories of its own. Its funds will be used rather to establish and support programs in existing universities and other institutions which are well fitted to carry on essential fundamental research. And this work will be really fundamental only if properly controlled by the foundation. Hence there is need right now for serious effort by chemical industry to make sure that effective provisions are set up for the support and control of this type of basic study.

The funds provided must be so arranged that the professors and other scientists directing this work can be suitably compensated for their skill and services. But this requires something more than the usual provision. If proper scientists are encouraged to become better teachers as well as researchers, they must have both their university salaries and the added compensation for the researches which they direct for the foundation. It is high time that college presidents find some way to insure this. When they do, they can keep the best teachers; and fortunately, they will find that these teachers are even better educators because they are doing valuable basic research, recognized and supported by federal funds.

If National Science Foundation can be persuaded by industry to support such a plan, it will have two major benefits. Directly it will improve the situation at the colleges where salaries are shamefully low. Indirectly it will result in emphasis on the type of fundamental work which should be done in universities and will reduce the financial temptation to seek the sort of applied research that belongs in the province of industry.

The Plant Notebook

THEODORE R. OLIVE, Senior Associate Editor



How to Drive Agitators Magnetically In Sealed Pressure Vessels

JOHN W. POSTLER, *Chemical Engineer, Cincinnati, Ohio.*

★ September Contest Prize Winner

Three years ago (*Chem. Eng.*, June 1947, p. 118) the writer offered a novel pressure compensated mechanical seal for rotating shafts, designed to minimize the leakage around shafts driving pumps and agitators. Since then the problem of eliminating even the small leakage permitted by a mechanical seal has come up, and the accompanying designs have been evolved. Two modifications of the principle of electromagnetic drive are shown here, although it will be obvious that many variations of the ideas presented can be worked out. It is realized, of course, that electromagnetic drive has been applied to centrifugal pumps as well as to flowmeters and level controllers. However, it is believed that the application to agitator drive is novel.

Industry has always been faced with the task of sealing rotating shafts, both in pressure and in vacuum operations, and often against corrosive, toxic and possibly radioactive materials. Rather than to attempt the difficult job of sealing such a shaft under difficult conditions, the present method eliminates the problem by placing the shaft and agitating device wholly within the sealed vessel, and transmitting the necessary energy to it electromagnetically. The problem first arose when I attempted unsuccessfully to locate a laboratory size agitator and heater combined. To overcome the lack the design shown in Figs. 1 and 2 was developed. It consists simply of a fiber-glass mantle containing a regular heating element, plus an added series of small electromagnets in a ring around the top of the mantle. These magnets are wound on soft iron cores and are energized in rotation by means of a mechanically or electrically driven brush contacting terminals arranged in a ring. A small permanent magnet sealed in plastic "chases" the induced magnets around the flask and so circulates the liquid. Terminal (1) is shown elongated (see Fig. 2) so as to give irregular motion and aid agitation.

To extend the simple idea of the laboratory agitator to plant size vessels requires a design capable of transmitting a fair amount of power. As Figs. 3 and 4 show, several powerful electromagnets are arranged around one end of the vessel. Six should be enough in most cases for smaller drives. If the vessel is of non-magnetic construction the arrangement shown for the lower magnet is suitable. But with a vessel of magnetic construction, a different arrangement is necessary, in which the magnets are recessed in the vessel end (as for the upper magnet) so as to concentrate the flux.

The permanent magnet rotor inside the vessel has as many poles (usually six) as the number of electromagnets. The electromagnets are provided with direct current alternately in opposite directions so that half of them present north poles, and half south poles to the rotor; then a reversal takes place and the first group present south and the second group north poles. The rotor magnets are repelled by the like poles and attracted by the opposite poles, as in Fig. 4. As the electromagnets change their poles, motion of the rotor continues.

There are various ways of changing the poles, one of the simplest of which is diagrammed in Fig. 4. An external commutating device consists of a ring of stationary commutator bars insulated from each other. In contact with the bars are six brushes carried on a rotor, with the brushes alternately positive and negative. The alternate brushes are connected through collector rings to the appropriate terminals of a suitable d.c. source. The two terminals of each

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★ OCTOBER PRIZE WINNER—A $50 prize will be issued to . . .

LESLIE SILVERMAN

Associate Professor of Industrial Hygiene, School of Public Health, Harvard University, Boston, Mass.

. . . for an article describing a simple way of constructing differential pressure gages from bottles, including an inclined draft gage of high accuracy, for easy levelling. Winner of the October contest, this article will be published in the December issue.

$50 PRIZE FOR A GOOD IDEA—Until further notice the editors of *Chemical Engineering* will award $50 cash each month to the author of the best short article received that month and accepted for publication in the Plant Notebook.

The winner each month will be announced in the issue of the next month, e.g., the November winner will be announced in December and his article published in January. Judges will be the Editors of *Chemical Engineering*. Non-winning articles submitted for this contest will be published if acceptable at space rates.

HOW TO ENTER CONTEST—Any reader of *Chemical Engineering*, other than a McGraw-Hill employee, may submit as many entries for this contest as he wishes. Acceptable material must be previously unpublished and should be short, preferably not over 300 words, but illustrated if possible.

Articles may deal with any sort of plant or production "kink" or short-cut that will be of interest to chemical engineers or others in the process industries. Also, novel means of presenting useful data, as well as new cost-cutting ideas, are acceptable. Address Plant Notebook Editor, *Chemical Engineering*, 330 West 42nd St., New York 18, N. Y.

electromagnet coil are then connected to the ends of adjacent commutator bars. At any position of the rotor, current will flow in one direction through coils 1, 3 and 5; and in the opposite direction through coils 2, 4 and 6. However, with each 60 deg. of clockwise rotation of the commutator rotor, the currents will reverse, thus carrying the agitator rotor around in synchronization with the commutator.

Fluorescent Test for Exchanger Tubes

In a recent issue of *Power* H. T. Duplice and R. C. Alexander, of the Department of Water and Power, Los Angeles, describe procedure used by the Bureau of Light and Power in testing condensers for leaks. The shell side of the condenser is filled with water containing fluorescein at the rate of 1 lb. per 12,000 gal. (The solution can be re-used repeatedly.)

In the case of the large steam condensers tested, the inspector then enters the water box, but with smaller heat exchange equipment, one of the tube side heads would be removed. Using an ultraviolet lamp (GE Type HGCH4 reflector-spot mercury vapor unit fitted with a Corning FS 5 ultraviolet filter) he projects the beam into the tubes, starting at the top and working horizontally across, from top to bottom. White light must be excluded from the test area. Any leakage shows as a brilliant yellow-green or red light (depending on the dye used in the fluorescein). The leaking tube is plugged with wood or fiber and the fluorescent solution washed off with a hose to allow the test to proceed.

After all tubes have been tested and leaking tubes plugged the tube sheet is flushed off and the test repeated to locate pin-hole leaks. Even on large steam condensers the testing time is only about 30 min., as compared with the 4 to 5 hr. required by earlier test methods.

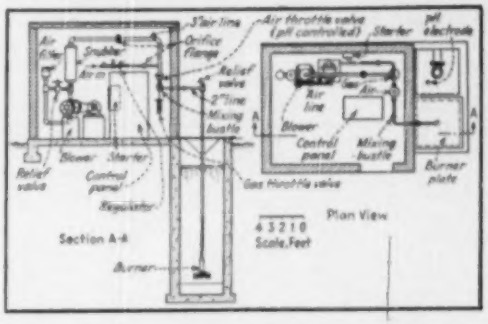
Watch Those Scale-Up Hazards

A recent issue of the *Sentinel*, fire insurance publication, calls attention to several explosions in chemical plants that occurred when apparently safe laboratory processes were being translated into pilot plant or full-scale operations. In one case a process safe in glass exploded when carried out in stainless steel due to a catalytic effect that may have been caused by traces of dissolved iron or manganese, or by the roughened surface of the steel which was etched by the acid. The process was abandoned.

In another case, the laboratory found that a process was safe if kept 100 deg. below a certain decomposition temperature. Despite precautions the process exploded when put into the plant. It was then discovered that many impurities that could come from the technical grades of chemicals used in the plant were capable of lowering the decomposition temperature to a point below the supposed safe temperature. Now all ingredients are mixed cold, sampled and tested in the laboratory before the process is carried out to make sure that there has been no accidental addition of something that would lower the decomposition temperature dangerously. If a dangerous decomposition is found, the batch is discarded.

Still another accident showed after investigation that although the Type 304 stainless kettle used was safe, a Type 316 stainless agitator had been installed by the supplier. The small trace of molybdenum that must have been dissolved from the agitator catalyzed an explosive decomposition.

The lesson from these accidents, the publication points out, is that everlasting scepticism must be exercised in translating processes from laboratory to plant to insure that unsafe conditions cannot arise from different construction materials, from industrial grades of reagents, from accidental substitution of chemicals or construction materials, or from slight changes in process conditions.



How to Use Submerged Combustion To Neutralize Alkaline Wastes

WILLIAM I. WEISMAN, *Ozark Chemical Division, Ozark-Mahoning Co., Tulsa, Okla.*

Strongly alkaline wastes often must be neutralized before discharge to a stream or sewer is permissible. To accomplish this sulphuric acid often is used and it is introduced by means of a chemical feeder. Sulphuric is preferred as the cheapest mineral acid available.

In most localities CO_2 actually is the cheapest form of acid available and the first source considered is flue gas which is thought of as being cost free. Before it can be utilized, however, the flue gas must be cooled, scrubbed, compressed, and diffused through the waste liquor. While the first cost of equipment for this purpose is not excessive, flue gases handled in this way are quite corrosive and operating troubles are frequent. Maintenance costs, particularly on the compressor, often are excessive. Hence this method is not too satisfactory.

A most convenient and efficient method of solving this problem is to produce CO_2 in the place needed and in the exact quantity required by means of a submerged combustion burner. The accompanying sketch shows such a unit. The blower handles clean, cold air; hence no corrosion problem arises. Combustion takes place under the surface of the water and cooling of the flue gases is immediate and complete. Combustion products can be controlled within very close limits.

If the flow is rather constant the unit can be set for constant CO_2 output by means of manual controls. If variations in alkalinity are frequent, automatic controls can be used which relate CO_2 output to pH of the effluent. Operation from 50 to 100 percent of rated output per burner is possible.

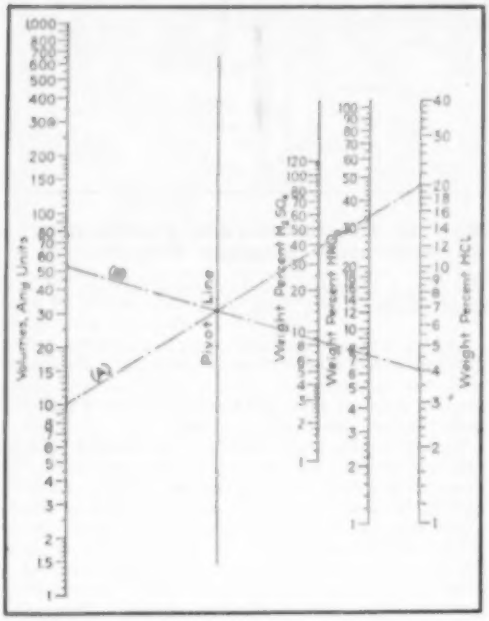
An example of the savings possible is shown as follows, but of course may vary for the particular locality:

Assume alkalinity to be neutralized in the waste liquor equals 100 lb. NaOH per hour. Using sulphuric acid, $2\ NaOH + H_2SO_4 \rightarrow Na_2SO_4 + H_2O$. Then 122 lb. 100 percent H_2SO_4 is required per hour for complete neutralization. If 100 percent H_2SO_4 costs $20 per ton, the cost is $1.22 per hr.

Using CO_2, $NaOH + CO_2 \rightarrow NaHCO_3$. Here 110 lb. of CO_2 is required per hr. for complete neutralization. This

is equivalent to 900 cu. ft. of methane. However, we assume 1,000 cu. ft. will actually be needed to allow for some loss of CO_2 not absorbed and reacted. Thus, with natural gas available at $0.25 per MCF., the same neutralization is accomplished for $0.25.

Where natural gas is not available, 9 gal. of propane will accomplish the same neutralization. Here the savings are not large but if propane is available at $0.10 per gal., or less, the savings may be substantial. In such cases the local prices of sulphuric acid and propane and the volume of waste to be neutralized will determine the most economical method to be used.



Dilution Nomograph for Aqueous Mineral Acid Solutions

W. C. Frisie, L. S. Ansell and Herbert Samuels, *Chemical Engineering Dept., Clarkson College of Technology, Potsdam, N. Y.*

It is often desired to make up aqueous solution of sulphuric, nitric and hydrochloric acids from more concentrated solutions. When a dilute solution of definite volume and concentration is needed, it is necessary to calculate the initial volume of the concentrated solution. If a definite volume of the concentrated solution is to be used, it may be necessary to find the final volume of the dilute solution or the concentration of a diluted solution of a definite volume. This entails the looking up of values of densities, conversions of volumes to weights, and the setting up of material balances; if the unknown is a concentration, a trial and error solution is necessary. These calculations and conversions are facilitated by the use of the nomograph from which any of the above unknowns can be found easily when three of the four variables are known. (A similar nomograph for inorganic salt solutions was presented by the authors on p. 123 of our October, 1950, issue.—*Editor.*)

A material balance of the solute shows that the following equations apply:

$$V_1 d_1 C_1 = V_2 d_2 C_2 \quad (1)$$

$$\log V_1 = \log V_2 + \log d_2 C_2 - \log d_1 C_1 \quad (2)$$

$$\log V_1 = \log V_2 + \log f(C_2) - \log f(C_1) \quad (3)$$

where V_1 and V_2, d_1 and d_2 and C_1 and C_2 are the initial and final volumes, densities, and concentrations by weight, respectively. The values of the product of the density and concentration were computed for each of these acids and the values were used as $f(C)$ in Eq. (3) to construct the nomograph by a method shown by Davis.[1]

The volumes are in the same ratio, therefore, any unit of volume can be used provided they are consistent for the initial and final volumes. This nomograph is based on 20/4 deg. C. data[2] and complete mixing is assumed. No appreciable errors appear within the range of 0 to 30 deg. C., provided the initial and final temperatures are the same.

As an example of use of the nomograph: Dilute 10 gal. of 38 percent by weight of sulphuric, or 34 percent by weight of nitric, or 20 percent by weight of hydrochloric acid to 8.3 percent by weight of sulphuric, or 7.3 percent by weight of nitric or 4.0 percent by weight of hydrochloric acid. What is the final volume of each solution? Connect the volume of the initial solution with its concentration by Line (A). Connect the final concentration with the intersection of the pivot line and Line (A) and continue this line (B) until it hits the volume axis. This is the final volume: 53 gal. for each. It should be noted that in diluting sulphuric acid, the acid should be added to the water.

REFERENCES
1. Davis, D. S., "Empirical Equations and Nomography," McGraw-Hill Book Co., Inc., New York (1943).
2. "International Critical Tables," McGraw-Hill Book Co., Inc., New York (1928).

Temperature Recorders as Cycle Timers

Robert L. Miller, *Northern Ohio Engineering Co., Barberton, Ohio.*

Most plants have one or more temperature recorders that are not in use or can be "robbed" for important jobs of short duration. At the same time, they often have points in the process that would benefit from a study of the work cycle, especially when the cycle is controlled by the human operator. Such a study can uncover many things, not only lax work, but also can find the operator who has developed some short-cut which he is keeping to himself. Discrepancies in cycle time will usually uncover such practices, since an operator can seldom "pad" the same amount of time over several cycles.

Although they are generally not thought of for such cycle study, temperature recorders can often do a good job if a little ingenuity is exercised in locating the bulb. They can, for example, be used in determining if and when steam or hot water valves are turned on momentarily, by placing the bulb in the condensate or hot water line. With the bulb in the ventilating air stream, they will show when motors are turned on. A characteristic temperature jump will show when an agitator is turned on, or when an exothermic reaction commences. Even time of sampling can be checked by requiring the operator to deposit a part of the sample in a vessel containing the bulb.

Once the characteristic mark on the record produced by these or other operations is known, cycles can be checked with surprising accuracy. Changes of less than a degree, and about 2 min. on a 24-hr. chart, can be spotted. Thus comparatively inexpensive recorders can be made into good supervisors, since the average operator is anxious to produce a good record when it is being charted. True, it is fairly easy to forge such records, but close study will usually ferret out offenders.



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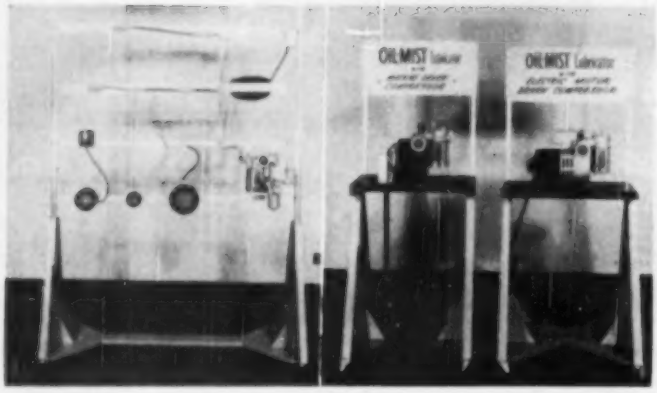
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Process Equipment News

THEODORE R. OLIVE, Senior Associate Editor



Displays showing, at the left, the new lubricator connected to a typical distribution system consisting of direct-connected bearings and precipitation nozzles; and, at the right, lubricators with direct-connected compressors for machine or electric drive.

Oil-Air Vapor System Developed for All Kinds of Machine Bearings

New method claimed to reduce lubrication costs by drastic oil economy, elimination of human factor.

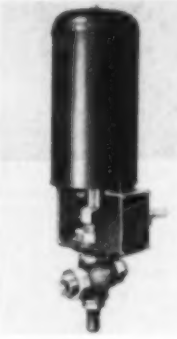
(172A) Continuous, controlled lubrication for almost any group of machine bearings can be handled economically, it is claimed, by the new Oil-Mist system of lubrication introduced by the Alemite Division of Stewart-Warner Corp. In this system oil is atomized by means of compressed air and the finer particles are separated out in the lubricator for transmission by a flow of air through small pipes to the point of use. These particles are so fine that they stay in suspension indefinitely and are consolidated as a lubricating film only as they impinge on the bearing surfaces.

In use of the new system the lubrication of each bearing is accomplished without measuring devices and is continuous as long as the machine is in operation. Oil in the bearing is continuously replenished at the proper rate, but is so small in quantity that a large saving in oil consumption is claimed. In addition to the virtual elimination of lubrication labor, the method is claimed to insure cooler running of the bearing. This comes about both through the cooling provided by a small flow of air through the bearing, and by limiting the amount of oil in the bearing and so reducing the "fluid friction." Furthermore, dust and abrasive materials are kept out of the bearing by the outward flow of air.

The lubricator proper is slightly smaller than an oil filter for a passenger automobile. It can be provided with air from a plant air line, from a small compressor driven from the lubricated machine, or from a small electrically driven compressor. Lubricators with built-in compressors of these two types are planned. Maximum air consumption runs about 1 cfm. For example, in one application with 20 lubricated points oil consumption was 1 oz. per 8 hr., using under 1 cfm. of air at 10 psi.

Within the lubricator is a venturi tube in which the oil is atomized by air. The oil-air mixture flows against a baffle which removes large particles, leaving only oil particles of about 20 microns in suspension. Control is exercised when the lubricator is first installed by adjustment of the built-in regulator on the air supply, and a needle valve controlling the oil flow. Thereafter, occasional filling of the oil reservoir is all that is needed.

Distribution to the various bearings involves simply making a connection through small diameter tubing. Up to 60 bearings, totalling not over 30 bearing inches (sum of diameters) can be connected to a single lubricator. Main distribution lines should not exceed 30 ft. in length, and branch lines should be limited to 10 ft. Connections to bearings are made direct, or through simple nozzles to precipitate the oil for open gearing. The system is applicable to both journal and anti-friction bearings.



OPEN-SHUT CONTROL:

Hydraulic Motor Valve

(172B) To give automatic operation by means of thermostats, pressure controllers, liquid-level or flow controls, Sarco Co. has introduced a new electrically operated hydraulic motor valve for open-and-shut control. For inaccessible locations, the valve may be manually operated by a pushbutton. The valve is suitable for handling such fluids as steam, water, oil, gas, and air at pressures up to 175 psi. for the smaller valves, and less for the larger. It is made in the single-seated type from ¼ to 6 in., and in the double-seated type from ½ to 8 in. Operation is through a small motor and rotary pump which forces oil

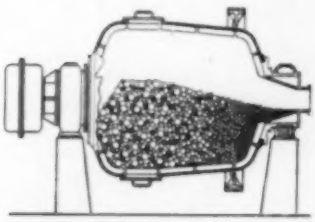
against a plastic-sealed piston in a cylinder to open the valve. Valve motion in the opposite direction is accomplished by returning the piston to its original position by means of a spring. Opening requires 60 sec., and closing 10 sec.



GIVES INCREASED SAFETY:

Solid-Front Gage

(173A) In the new solid-front Acragage made by Clapp Instrument Co., the gage case has a solid cast web backing up the dial, with the entire back of the gage case covered by a waterproof blowout disk, with bonded Buna N seal. In the event of bourdon tube rupture, the blowout disk relieves the pressure away from the operator and without danger of rupture of the glass lens. Since the blowout disk is readily removable, the entire mechanism is easily available for inspection, repair or recalibration, without removing the dial. These gages are produced in diameters from 4½ to 10 in., for pressures from 30 in. vacuum to 80,000 psi. Standard movements are of stainless steel, or nylon and stainless.



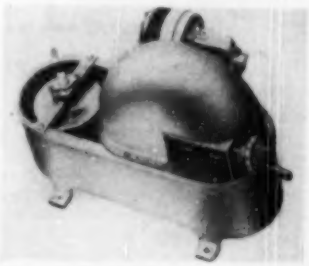
GRINDS WET OR DRY:

Three-Cone Mill

(173B) After several years of testing, Hardinge Co., Inc., has now put its new Tricone ball mill on the market. The important feature of the new mill is its slightly tapered shape which is said to keep the larger grinding balls at the feed end of the mill. Claimed to embody the good features of the company's well-known conical mill, the new design also provides additional room for smaller grinding media at the discharge end, with virtually the same floor space requirements.

The mill consists of a conical or convex feed head, a short cylindrical section, a long tapered conical section, and a wide-angle conical or convex discharge head. Since it is basically a combination of three truncated cones of varying angles, the mill has been named the Tricone.

The new construction is said to assure proper ball segregation with the larger balls always remaining at the feed end to crush the coarser incoming material. Maximum energy is gained at the feed end where the diameter is greatest and greatest crushing force is needed. The convex heads are said to increase ball turbulence and eliminate dead corners, while the nearly spherical shape provides maximum working volume for minimum liner surface. This means lower over-all mill dead weight, less bearing friction, lower power and lower liner consumption per ton of material ground. Furthermore, with the larger balls kept away from the discharge, there is said to be less wear on the discharge grate when one is used.



HANDLES LIQUIDS:

Reagent Feeder

(173C) Clarkson Co. is now manufacturing a liquid reagent feeder of the cup and disk type which is built of stainless steel for feeding liquid reagents at rates from several drops up to as much as 2,000 cc. per minute. For highly specialized jobs the feeder can be provided with a Teflon coating. The feeder consists of a rotating vertical disk, the lower part being submerged in a tank. Cups on the periphery of the disk (which can be varied in number from 1 to 20) elevate the liquid and then discharge it over a flow splitter which accurately adjusts the amount delivered, returning the

More Information . . .

To learn more about any item described here, circle the item number on the Reader Service Postcard inside the back cover.

This Month . . .

As we promised last month, this department has now been increased to a total of ten pages, which doubles the average for the last five years. Spread out for your interest are about 60 items, ranging from those where a few words will do the job, to other items where a column or more is necessary to tell what we feel is needed. Try out the new, expanded department, and tell us how you like it. Can we help you still more? If so tell us how. In the meanwhile, here are some of the highlights of later pages: A new combination of ideas in dust collectors on p. 178; a real improvement in flexible couplings on p. 180; and a control valve especially for slurries on p. 182. Many will be interested in the novel viscometer on p. 184, and others in the low-power vibrating conveyor on p. 186.

Next Month . . .

The expanded department will continue next month, and as long thereafter as necessary. Some of next issue's features will be a fire protection system permitting instant choice between wetting agent and foam; new radiant heating panels of glass; a sedimentation tank for softeners of spherical shape; and a brand new type of steam trap.

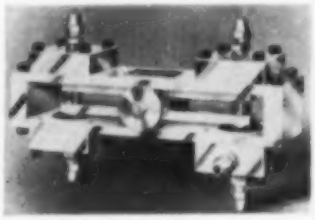
Marshall and Stevens Indexes of Comparative Equipment Costs

(1926 = 100)

Compiled quarterly for March, June, September and December of each year by Marshall and Stevens, evaluation engineers, Chicago and Los Angeles. Indexes are prepared for 47 different industries, from which the eight process and four related industries listed here are selected. Published each month with the latest available revision. For a description of the method of obtaining the index numbers see R. W. Stevens, **Chemical Engineering**, Nov. 1947, pp. 124-6. For a listing of annual averages since 1913 see **Chemical Engineering**, Feb. 1950, p. 128.

Industry	Sept. 1949	June 1950	Sept. 1950
Average of all	159.6	168.1	171.5
Process Industries			
Cement mfg.	155.9	158.1	163.4
Chemical	163.4	166.1	171.4
Clay products	150.4	153.1	158.4
Glass mfr.	152.5	156.2	161.5
Paint mfr.	156.7	159.4	164.7
Paper mfr.	157.0	159.7	165.0
Petroleum ind.	159.8	162.5	167.8
Rubber ind.	162.2	164.9	170.2
Process ind. avg....	160.9	163.5	168.9
Related Industries			
Elec. power equip...	165.0	167.7	173.0
Mining, milling	164.1	166.9	172.1
Refrigerating	178.9	179.4	190.8
Steam power	152.1	154.8	160.1

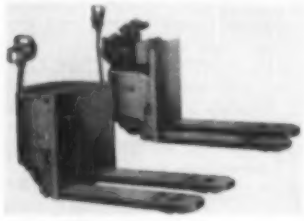
rest to the feed reservoir. Accuracy is said to be within a few drops per minute. The supply tank is automatically maintained at the desired level by means of a stainless steel float valve. Thermostatic temperature control can be incorporated, if desired.



FOR CONTROL USES:

Ratio Totalizer

(174A) A new device which can receive and combine several control signals or pressures to produce a single output loading pressure in any ratio to the incoming load is being offered by Hagan Corp. The device can be used in control circuits for introducing proportional, rate and automatic reset actions, separate or in any desired combination. It is also expected to find application in computing circuits for such functions as addition, subtraction, multiplication and division of control signals. The device consists of a frame carrying diaphragm elements in each of four chambers. Connecting the diaphragms is an arm supported on an adjustable fulcrum. Any input pressure chamber may be fitted with an adjustable tension spring, or bellows type elements may be substituted for the diaphragms for higher pressures. The device is said to be sensitive and accurate, enabling many special control problems to be worked out.

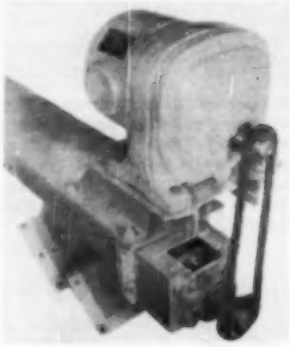


GAS OR ELECTRIC:

Power Hand Trucks

(174B) Clark Equipment Co. has recently introduced a new line of power hand-lift trucks for pallet handling, produced in two types, one battery-powered, the other gasoline-engine powered. The first is known as the Electro-lift, and the second as the Hydro-lift. Both types claim to have the shortest turning radius and shortest wheelbase of any truck of this type, combined with high maneuverability, ample power and accessibility for easy maintenance. They use mechanically self-energizing brakes, said to be the largest found in any hand truck.

The electric model is said to have the greatest power of any electric-powered hand truck. In the gasoline driven type, the engine drives a hydraulic pump and motor, said to be the first drive of this type in the materials handling field. Exceptionally smooth, non-stalling operation is claimed. Both models, rated at 6,000 lb. load capacity, employ hydraulic lifting.



DUST-TIGHT DESIGN:

Screw Conveyor Drive

(174C) Pictured above is an improved dust-tight drive for screw conveyors recently perfected by Kornylak Engineering Corp. This design incorporates a stuffing box with a bronze follower, packed with rings of square graphited packing. It employs a grease-sealed ball bearing with open air space between bearing and stuffing box. The stuffing box is readily accessible for taking up on the packing and the packing can be removed without disassembly. This new dust-tight construction is available as a part of complete screw-conveyor installations fabricated by this concern.

EASILY CLEANED:

New Pressure Switches

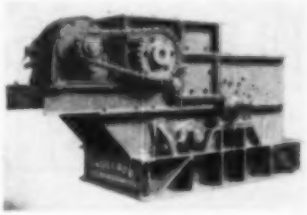
(174D) New Meletron pressure-actuated switches announced by Barksdale Valves include the Model 450 Sanitrol which is suitable for actuation by heavy, dirty or viscous liquids and powders and is readily disassembled for cleaning; and the Model 427 differential pressure type for sensing the difference between a variable and a fixed reference pressure. A diaphragm actuates a single-pole, double-throw switch when the variable pressure is different from the reference pressure. Both are suitable for either a.c. or d.c. circuits.



SIMPLIFIES CLEANING:

Angle Hammer Mill

(174E) For grinding operations requiring easy cleaning or maximum sanitation, Rietz Mfg. Co. has developed a new angle disintegrator which permits ready and complete exposure of all contact surfaces. Take-down and assembly time are said to be only a few minutes. It is claimed to be impossible for lubricant to mix with the through-put owing to the location of the drive shaft below the hammers and 360-deg. discharge screen. The new machine retains the dual discharge feature of this company's other disintegrators whereby materials which resist pulverization are separated from the primary product and passed by gravity through the hammers and out the secondary discharge. The new model is belt-driven at rotor speeds ranging from 7,200 to 16,000 rpm. in smaller units and from 3,600 to 7,200 rpm. in larger units. All parts are stainless steel.



HANDLES STICKY MATERIALS:

Non-Clog Mill

(174F) Redesign of its line of moving-breaker-plate hammermills has been announced by Hammermills, Inc. These mills are intended primarily for

(Continued)

now you can ship molten sulphur in a GATX TANK CAR



The GATX molten sulphur car is a typical example of General American's continuous research and development for the chemical industries. This car makes it possible, for the first time, to ship sulphur in a molten state. Slow, expensive solidifying and re-liquefying at origin and destination are no longer necessary.

Pour molten sulphur (approximately 305°F.) directly into this newly developed GATX car.

At destination, unload directly into the manufacturing process.

6-in. insulation retains heat. Heater coils in the GATX molten sulphur car permit unloading of hot liquid sulphur. From the car it goes to the burners for processing.



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bulk shipping keeps pace with chemical progress

crushing sticky or high-moisture materials. New features include easily accessible and adjustable controls for producing various finished product sizes, together with heavier shafts and anti-friction bearings. Furthermore, steels of improved analysis are being used for resistance to wear and abrasion of hammers, liners, breaker plates and grate bars.



IMPREGNATED WITH TEFLON:

Braided Packing

(176A) Known as Palmetto 1330, a new braided packing prepared from chemically pure blue asbestos yarn impregnated with Teflon is being offered by Greene, Tweed & Co. for resistance to acids, alkalies, corrosive chemicals and solvents in the range from −150 to +550 deg. F. The same process used in impregnating this company's other self-lubricating packings is used to impregnate the yarn, after which it is braided. The new packing comes in sizes of ⅛ in. square, and up, and is recommended by the makers for extremely difficult services where conventional packings fail.



FOR CONSTANT TENSION:

Slip Clutch

(176B) To handle problems of maintaining constant tension or constant torque in winding operations, Hilliard Corp. has developed a new slip clutch which features ventilated plates, cooling fins and pressure springs with long deflection range for accurate adjustment. Single, double, and triple plate construction is available. When the intention is to produce constant tension, the regular adjusting nut is replaced with a sliding collar to permit adjustment while the unit is in operation. Clutches are offered in sizes from 2½ in. to 27 in. diameter, with torque range up to 10,000 ft.-lb., and heat capacity up to 8½ hp. The clutch is useful in winding operations in paper and plastic industries, and can also be used as a safety device for overload protection.



PRE-ENGINEERED, FLEXIBLE:

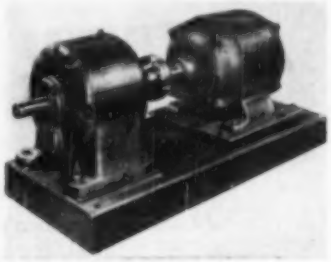
Switchboard System

(176C) Under the name of Centr-A-Power, Trumbull Electric Mfg. Co. has announced a new type of custom-built, pre-engineered switchboard designed to centralize power and lighting switching in one dead-front, free-standing package. The new system consists in using a series of vertical rigid steel troughs into which are inserted all types of switching devices. All troughs are connected by continuous power bus which may be fed from the bottom or top of the trough. Individual switchboard units take power from silver-plated, vertical bus bars by means of spring-loaded stabs which are attached to the back of the units. Each unit is mechanically and electrically isolated from other units in case of faults or short circuits. Depending on size, the troughs can handle circuit breakers up to 1,600 amp. and fusible switches up to 1,200 amp., 600 volt maximum.

PROTECTS WATER STILLS:

Low-Water Cutoff

(176D) For the protection of both its laboratory and its industrial water stills against low water level, Precision Scientific Co. is now offering an electronic low-water cutoff known as the Lectrol. The device automatically shuts off the heat source when the water supply to the evaporator is insufficient, automatically turning it on again when the water supply returns to normal. It is designed to fail safe in event of power failure or other failure. In addition to the electronic relay system and signal light, the device includes a water probe situated in a cup attached to the evaporator. The device can be used on any gas or electric water still.



MOTOR-REDUCER COMBINATION:

Compact Drive Unit

(176E) As a companion to its line of gearmotors, Link-Belt Co. has developed a new packaged power unit called the "Motogear." This consists of a compact, inclosed helical gear drive with separate standard motor, flexibility coupled and mounted on a welded steel base plate. A movable plate between the motor feed and the welded base plate provides for convenient adjustment, should shaft realignment be necessary for any reason. The new unit is built in a variety of sizes, in double or triple reductions, and in a wide range of ratios and in horsepowers from 1 to 75 hp. In all types, input and output shafts are concentrically in line.



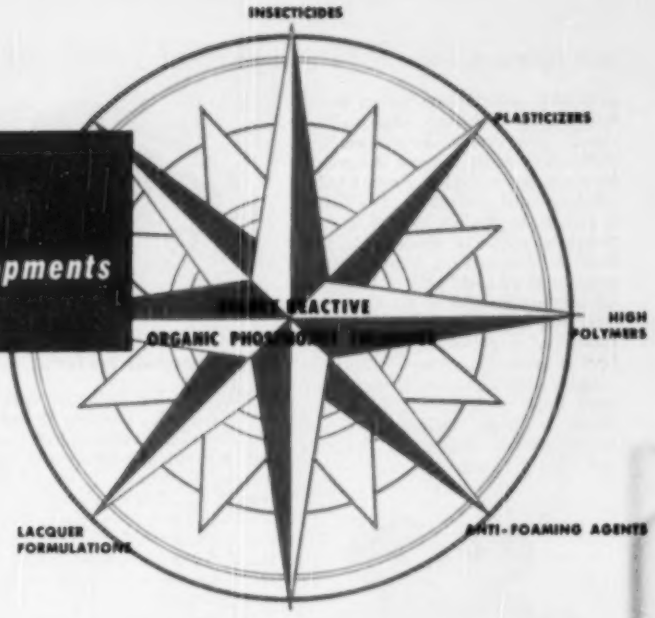
LINED WITH POLYETHYLENE:

Drums and Pails

(176F) Application of polyethylene linings on a mass production basis to steel drums, pails and hackney-type drums has been announced by the Delaware Barrel Co. This often enables ordinary 18-ga. steel drums or

(*Continued*)

pointing the way to successful new developments



3 IMPORTANT INTERMEDIATES NOW AVAILABLE IN COMMERCIAL QUANTITIES

The commercial availability of this group of organic phosphorus chlorides will be of special interest to research chemists. Already these three chemicals have proved useful as intermediates in organic synthesis for applications in insecticides, plasticizers, high polymers, lacquer formulations, anti-foaming agents, and others.

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☐	☐	Benzene Phosphorus Oxydichloride	258°	1.5580	1.375 @ 26°C
☐	☐	Benzene Phosphorus Thiodichloride	305° @ 130 mm	1.6210	1.376 @ 13°C

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pails with polyethylene linings to be used instead of heavier gage steel or special alloy drums. It also enables materials formerly shipped in wooden barrels to be handled in low-cost polyethylene lined containers. The lining is said to be flexible so that it continues to adhere if the container is bent or damaged in transit. Since coatings of 10 to 30 mils in thickness (depending on the application) are used, and are thoroughly spark tested, possibility of permeability is said to be eliminated. Drums are continuously reusable after simple washing. They have been used successfully against many materials, including mineral acids, alkalies, detergents, dyestuffs and latex products.

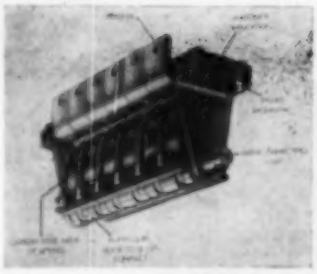


BUTTERFLY DISK TYPE:

High Vacuum Valves

(178A) For all high vacuum applications the F. J. Stokes Machine Co. has announced a new series of high vacuum disk valves designated as Model 211. These valves are of the butterfly type, produced in sizes from 6 to 12 in. Both larger and smaller sizes are also available. The valves feature ease and speed of operation, as well as compact design, owing to the small space requirements of a butterfly disk as compared with diaphragm and plug closures of equivalent capacity. Only ten turns is required to open or close the valve, compared with twice that number of turns for other types. Tight closure is claimed in the closed position.

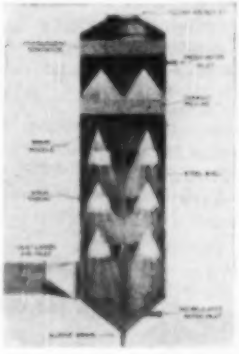
Use of a cam-actuated valve disk is said to assure positive seal and provide a large mechanical advantage at the initial opening and final closing stages, to overcome the high pressure differential across the valve face. Other features include a position indicator and an access opening for convenient inspection and replacement of the sealing gaskets.



FOR ELECTROCHEMICAL PROCESSES:

Short Circuit Switch

(178B) To facilitate repairs of electrolytic cells, enabling an individual cell to be shunted out of the circuit without disturbing the entire process, Railway & Industrial Engineering Co. has developed the new TTC short circuiting switch. This device is mounted alongside of an individual electrolytic cell, remaining open when the cell is in operation. When closed, the switch shunts out the cell. The switch is rated at 2,500 amp. in single units, but multiple units can be arranged for increased amperage requirements. All contact surfaces are silver-faced, with high-carbon backup springs to assure positive contact. An auxiliary switch connected to the operating shaft can be provided if desired for control and signalling purposes.

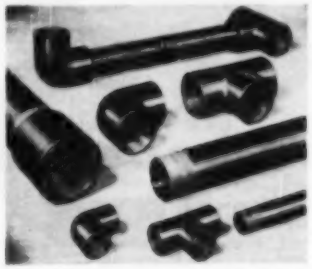


COMBINES THREE PRINCIPLES:

Dust Collector

(178C)

Now being built by the Prater Pulverizer Co., the Pemasco Dust Master collector is said to be capable of recovering industrial dusts which cannot be suppressed successfully by conventional types of wet or dry centrifugal collectors. The system combines in one unit an impingement type collector, a spray tower and a packed tower. As the illustration shows, the incoming dust-laden gases impinge against the wetted lower walls and vanes of the chamber. They are then forced upward through a series of throat plates, each throat being fitted with an overhead spray nozzle filling the throat opening completely with finely divided spray. After passing through several stages of throat plates, the air passes upward through a bed of water-sprayed ceramic packing having 52 sq.ft. of surface area per cubic foot and thus presenting great impingement area. Finally, the cleaned air passes through a dry ceramic packed bed for entrainment separation. Being without moving parts, the unit is claimed to present no maintenance problem.



USES SCREWED JOINTS:

Plastic Pipe

(178D) Adding to its line of plastic pipe, Carlon Products Corp. has developed the new type TL for temperatures to 140 deg. F. which is produced in threaded sections up to 20 ft. long, together with molded plastic fittings. The new pipe can be threaded and cut in the conventional manner with standard tools to produce leak-proof screwed joints. Fit-up is said to be rapid. The pipe is light in weight (approximately one-ninth the weight of steel) and is suitable for a wide range of corrosive service. Standard diameters range from ¼ to 2 in. Plastic ells, tees, adapters, plugs and other fittings are available.

SMALL VERSION:

Variable Speed Drive

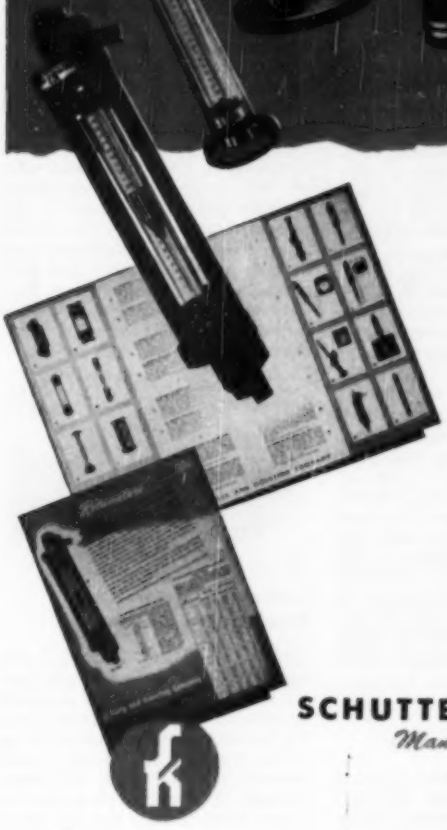
(178E) Speed Control Corp.'s latest development is a smaller version of the Specon variable speed drive described in our October 1944 issue. This is rated at ½ hp. in the non-reversing model, and ¼ hp. in the reversing type. Designated as Type OOED, the drive gives infinitely variable speed variation

(Continued)

YOUR FLOW METERING PROBLEM

May Already be Solved...





...by one of the SK Rotameters in our standard line.

That's why it would pay you to investigate—acquaint yourself with the numerous types and sizes we have to offer.

Many years of experience in solving hundreds of customer problems have helped us to design a group of Rotameters sufficiently diversified to meet most industrial requirements. However, should your problem differ from others so radically that one of our standard types won't solve it, you can count on our engineers to give you all the help possible in designing a new unit which will.

Bulletin 18-RA, shown at left, pictures and briefly describes the construction and principle applications of all standard SK Rotameters. It's yours for the asking.

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through use of a novel combination of an a.c. squirrel cage motor driving two d.c. motors through a differential gear. The latter are electrically connected and require no outside power.



USES STRIP CHART:

Electronic Recorder

(180A) Announced by the Bristol Co., the new Series 500 Strip-Chart Dynamaster electronic recorder is a high speed, self-balancing a.c. bridge for measuring temperature, resistance, conductivity and other variables which can be measured in terms of impedance. The instrument can also be used for electric power totalization and as the receiver for this company's Metameter system of telemetering. Recorders equipped to make up to 16 records on the same chart are available. Full scale pen travel can be had in 7, 3 and ¾ sec. Chart speeds range from 1 to 120 in. per hour. Supplementing the line of recording instruments is a similar line of automatic controllers in both electric operated and pneumatic types.

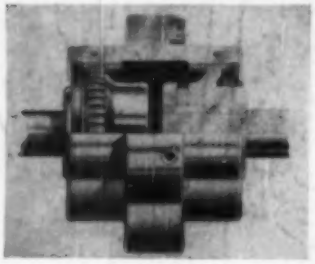


FOR VISCOUS LIQUIDS:

Steam-Jacketed Pump

(180B) To permit the handling of viscous liquids at high temperatures, Schutte & Koerting Co. is now offering a steam-jacketed, herringbone-gear pump in which the jacket completely covers all internal pump parts. The inlet, outlet and cover flanges are cast integral with the pump base to prevent possibility of distortion due to pipeline strain or misalignment. A straight-bore housing prevents shaft deflection and bearing overhang. Pressure on the stuffing box is dissipated through a channel in the cover plates. The steam connections to the jackets are readily accessible and designed to permit a variety of piping arrangements.

The complete rotor and bearing assembly can be removed as a unit simply by releasing the coupling and removing the rear cover. These pumps are produced in such materials as Meehanite B, cast steel, bronze or a variety of special alloys.



DIHEDRAL TOOTH DESIGN:

Flexible Coupling

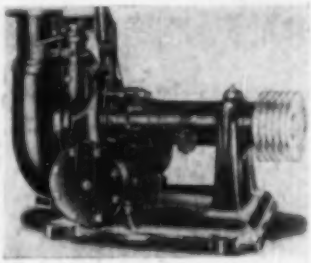
(180C) Angular and offset misalignment up to 7 deg. can be handled with the new Dihedral flexible coupling manufactured by Ajax Flexible Coupling Co. Special designs can take care of misalignment up to 12 deg. One of the principal new features of the coupling is the unusual tooth form, using dihedral surfaces on the splines so as to give a tooth thicker at the middle than at the ends. Under conditions of misalignment this is said to provide more tooth contact than with teeth of any other shape, permitting maximum misalignment with minimum clearance or backlash.

This design is said to contribute to long life, cool running and quiet, chatter-free operation. Couplings are available for shaft sizes from 1¼ to 5 in. diameter, for transmitting from 12 to 350 hp. at 100 rpm. Since they allow maximum misalignment, they are said to simplify machine design and installation by eliminating need for precise alignment, while they also take care of bearing wear, foundation settlement and alignment changes due to temperature changes.

STAINLESS STEEL:

Liquid Sample Cooler

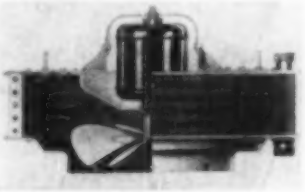
(180D) Worthington Pump & Machinery Corp. is now offering a cooler for sampling chemicals, refinery products and boiler water which consists of a small shell and tubular coil heat exchanger of stainless steel construction. By employing counterflow, samples are cooled almost to the temperature of the cooling medium inlet. The cooler handles up to ½ gpm. and is 3½ in. in diameter by 11½ in. long.



EASIER MAINTENANCE:

Centrifugal Sand Pump

(180E) A new model K heavy-duty centrifugal sand pump developed by A. R. Wilfley & Sons features improvements in hydraulic design which are said materially to increase pumping efficiency. Furthermore, the mechanical design has been modified to simplify maintenance and facilitate the replacement of the rubber-lined or special alloy intake chamber. An improved check valve is said to eliminate leakage, give longer check valve life and better bearing protection. Wearing parts are removed readily without disturbing the intake or discharge piping. The pump is produced in both direct-connected and belt-driven types, in sizes from 1 to 8 in. discharge. Rubber-covered wear parts are available for all sizes and are interchangeable with hard-iron parts.



COMPLETELY REDESIGNED:

Projection Heaters

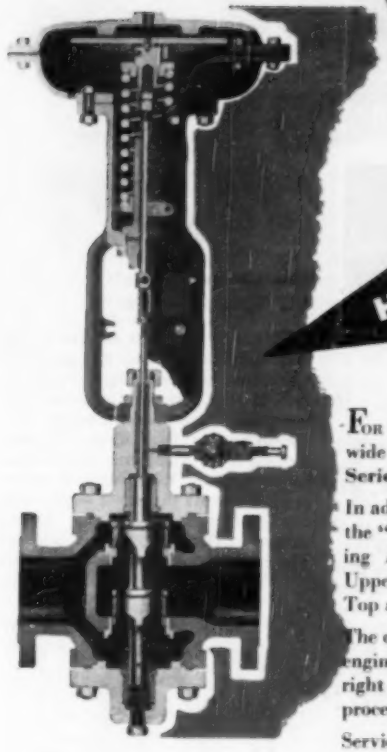
(180F) Trane Co. has redesigned its line of projection unit heaters for greater rigidity and improved appearance. Only the motor and housing brackets protrude beyond the top of the new unit. All bracing is done beneath the top plate for added strength. It is possible to remove the motor either through the top of the

(Continued)

• There are many diaphragm control valves... but

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HONEYWELL SERIES "700"



For a diaphragm-operated valve that affords utmost precision in wide band proportional control . . . your best bet is the Honeywell Series "700."

In addition to the usual features you expect to find in a fine valve, the "700" gives you: Pre-molded Neoprene Diaphragm with Rolling Action, Pivot-Mounted Inner Plate and Cradle-Mounted Upper Spring Flange, Duplex Bearing for Stem, One-Piece Bonnet, Top and Bottom-Guided Disc.

The quality of the Series "700" stems from years of research and engineering know-how . . . in designing the right valve, from the right material, with the right specifications for the more complex process applications.

Service, when needed, is available from the Honeywell nationwide network of branch offices and factory-trained field engineers . . . as near to you as your phone. Call in your local Honeywell engineer today . . . for detailed information.

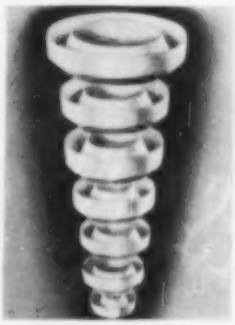
Investigate the Series "700" . . . today . . . write for Bulletin 700-2

Minneapolis-Honeywell Regulator Co., *Industrial Division*, 1904 Windrim Ave., Philadelphia 44, Pa. Offices in more than 80 principal cities of the United States, Canada and throughout the world.

Honeywell

VALVE PRODUCTS

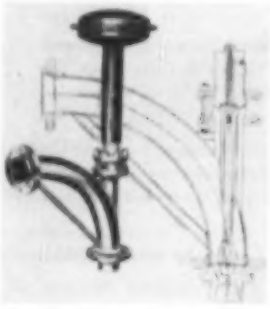
unit or through the discharge orifices on larger models. The new series includes a new size for 451,000 Btu. capacity. In addition the line includes models ranging from 55,300 Btu. to 550,000 Btu. per hr. In these heaters a new hydraulically expanded coil is used, the tubes being expanded under a pressure of 3,000 psi.



MADE OF TEFLON:

V-Ring Packing

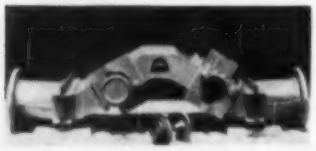
(182A) Crane Packing Co. has added to its line of Chemlon packings a Teflon V-ring packing suitable for temperatures up to 450 deg. F. The new ring is virtually frictionless and chemically inert. It is claimed to cause no wear on the stem or shaft and to insure a perfect, permanent seal with just fingertight pressure on the gland. Many standard sizes are now available, while additional sizes can be molded to meet specific requirements.



LONG SWEEP TYPE:

Angle Control Valve

(182B) For minimizing turbulence in flow control and for handling slurries which tend to plug conventional type control valves, Hammel-Dahl Co. has introduced a long-sweep angle control valve which is said to operate successfully with any material that can be pumped. The valve body is a long-radius bend which can be fabricated from any type of pipe which can be bent and welded. The valve plug is streamlined to offer minimum flow resistance. The plug guide is extremely long to assure ample guiding even when the plug is operating close to the seat. Plugs are of the high-lift type, normally one-half the nominal valve diameter. The seat is designed as a section of a venturi throat to assure minimum turbulence, and the valve is single-seated to assure tight shutoff. Since the body has the same cross section as the connecting line, maximum seat size is one-half the nominal pipe area. These valves can be provided in any size from 2 to 6 in. and in a variety of construction materials and trims.



HANDLES LARGE FLOW:

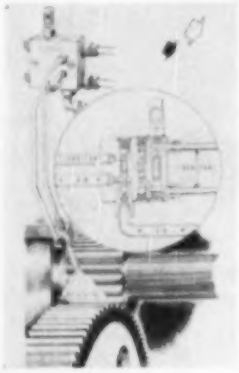
Magnetic Separator

(182C) Latest development in the Eriez Mfg. Co. line of permanent magnet separators is a pipeline separator for large flows, suitable for lines in diameters from 6 to 20 in., for handling from 50 to 250 cfm., depending on consistency. The separator employs what is called a "pressure hump." Flow is directed at 30 deg. from the normal straight line so that two stainless steel plate-type magnets installed on opposite faces of the hump can set up a magnetic barrier in tandem; what one misses, the other is said to catch. Use of stepped pole plates on the downstream side of each magnet provides a recess from which entrapped iron can be dislodged. For cleaning purposes, however, there are two pressure-tight handholes in the side plates.

VARIETY OF LENSES:

Radiation Pyrometers

(182D) Brown Instrument Div. of Minneapolis-Honeywell has added to its line of radiation pyrometers so that the line now includes instruments covering the entire range from 125 to 7,000 deg. F. Included among these Radiamatic instruments is one with a calcium fluoride lens for the range of 200 to 1,200 deg. F., another with a fused silica lens for 800 to 2,300 deg. and a third with a Pyrex glass lens for 1,000 to 3,200 deg. F. Another, chiefly for moving objects, covers the range of 125 to 350 deg. In still another group the lower range is from 1,700 to 3,200 deg., and the very high range from 3,000 to 7,000 deg., intended for very small objects or a small area of large objects.



LUBRICATES OPEN GEARING:

Oil Spray Valve

(182E) What is said to be the first adequate method for providing lubrication to open bearing surfaces, such as slide surfaces and open gearing, is the new lubricant spray valve offered by the Farval Corp. The new method is an adaptation of the company's Dualine valve whereby grease or oil is sprayed through a nozzle onto any desired area, in any desired amount and at any desired interval. The new valve can be added at any

(Continued)



FLOATLESS UTILITY PUMP

(182F) **A general purpose centrifugal pump which operates completely submerged has been developed by Kenco, Inc. The entire unit is of bronze construction, operated by a floatless liquid-level switch control which is said to operate unfailingly. If desired, however, the pump may be operated manually. It will draw to within ¼ in. of the bottom of the vessel or pit in which it is used.**

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Breakage is costly in many ways . . . to you, to your customers! All plies of Chase SHARKRAFT are crinkled to give "shock-absorbing" elasticity, assuring much greater resistance to breakage! The "shark-skin" crinkling of SHARKRAFT provides a sure grip—makes for easier handling and better stacking qualities. Available in choice of 2 to 5 plies. Furthermore, you'll find that the sharp, colorful printing and the attractive appearance of SHARKRAFT bags help stimulate the sale and acceptance of your product. Get the facts on this better container . . . Chase SHARKRAFT . . . mail coupon TODAY!



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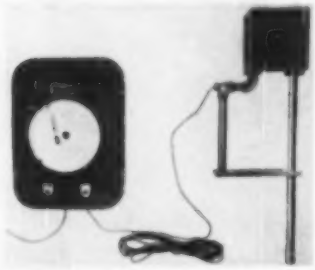
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point in a regular Dualine system where compressed air is available. Compressed air from the supply line is directed through the spray valve, which meters air to the delivery nozzle just as lubricant is metered. The lubricant valve itself turns on and shuts off the air so that the amount used is limited to that needed to spray each delivery of lubricant. After each delivery there is positive cutoff of lubricant to eliminate bleeding from the nozzle.



FACILITATES PROCESS CONTROL:

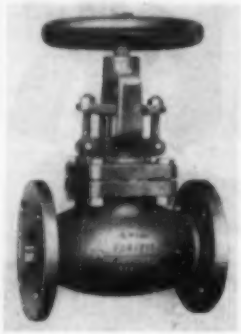
Recording Viscometer

(184A) Utilizing a timing principle somewhat similar to that used in fundamental viscosity measuring instruments, Norcross Corp. has developed a recording viscometer which is said to be applicable in the entire range from 1 to 200,000 centipoises. This instrument has been used in the textile industry, but is only now being offered for general industrial application.

The sensitive element consists of a plunger or piston contained in a vertical tube. A motor-driven mechanism lifts this plunger periodically, then allows it to drop by gravity. A sample of the liquid being measured is drawn into the tube through orifices as the plunger is raised, and expelled when the plunger drops. The time required for the plunger to drop is a measure of the viscosity and this measurement is transmitted to the recorder through a multi-conductor, color-coded cable. In the recorder, the time measurement is converted into chart readings by means of motors, relays and other associated parts.

For applications where it is required, an explosion proof measuring element can be supplied, meeting Class 1, Group D requirements.

The instrument normally employs a 24-hr. chart and is without automatic control, but can be supplied as a recorder-controller. In addition, it provides a high-low viscosity alarm which can be adjusted at the recorder to various values. The instrument can be used under pressure or vacuum conditions and can be furnished for explosion-proof applications if desired. There is no restriction on the distance between the measuring assembly and the recording instrument.



COMPLETE NEW LINE:

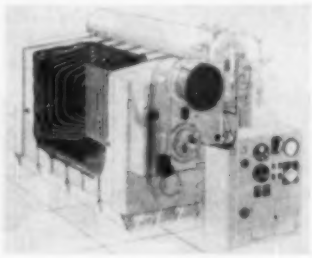
Stainless Steel Valves

(184B) Addition of a complete line of stainless steel valves to its regular line of cast steel valves has been announced by Pacific Valves, Inc. These valves can be provided in stock from this company's 316 Alloy (Type 316 stainless) or Alloy 20. The line includes 150 lb., 300 and 600 lb. types in gate, globe and check designs. Depending on type, sizes range from ¼ to 8 in., most valves being of outside-screw-and-yoke construction. The valve illustrated is the 150 lb. globe type, made in sizes to 6 in.

FEATURES RATE ACTION:

Electric Controller

(184C) What is said to be the first electrically actuated controller which includes a rate-action component in its characteristics, in addition to proportional and reset control actions, is the new P. A. T. 50 controller offered by Leeds & Northrup Co. Rate action responds according to the speed with which the controlled variable changes and thus improves control by reducing the length of time that an upset can force the controlled process off its set point. In furnace operation, for example, if temperature falls, rate action opens the valve wider the faster the drop in temperature occurs. The controller is also applicable to control of pH, chemical concentration and gas analysis. The key element of the control system is a new unit which electrically links a Micromax or Speedomax recording instrument to the electric valve drive mechanism. The new control unit has no moving parts, working entirely by electronic circuits.



WATER-TUBE TYPE:

Pre-Assembled Boiler

(184D) To provide power or process steam at loads ranging from 7,000 to 25,000 lb. of steam per hour, and pressures up to 250 psi., Babcock & Wilcox Co. has developed the new type FM integral-furnace boiler. This is a shop-assembled, self-contained steam generator employing water tubes and a completely water-cooled furnace. Shipped as a unit, its cost and time of installation are thus reduced. Its advantages of compactness, portability, simplicity, reliability and safety are said to fill a need in both large and small industrial establishments.

If necessary, the boiler can be relocated at any time after original installation. It is equipped for push-button start and stop and provided with automatic control for handling variations in load, making it suitable for plants whose operators attend to other essential duties. Fast steaming, high efficiency, and firing by oil, gas, or combination gas and oil (with easy changeover) are other advantages. Since the entire boiler and furnace are inclosed in a rigid steel casing, outdoor installation may be made, if desired.

DOUBLES LIFE:

Transformer Finish

(184E) For use on its distribution transformers, Westinghouse has developed a new three-coat, mica-base paint system which has been given the name of Coastal Finish. Each coat works cooperatively with the others to withstand oxygen, acids, salts, alkalies and other corrosive atmospheric constituents found in seacoast and industrial atmospheres. The first or prime coat is applied after the metal has been cleaned and treated with phosphate solutions. This coating is

(Continued)

another
LIMITORQUE
Advantage . . .

MORE COMPACT DESIGN



LimiTorque Valve Controls are definite space savers because of their extremely compact design and construction. Often they can be installed in "close-quarters" where some other types of valve operators cannot be accommodated.

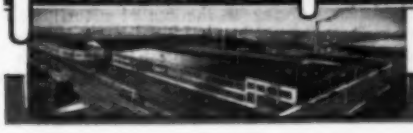
Remember . . . there are many distinctive construction and operating advantages offered by LimiTorque which assure more dependable and satisfactory performance. We will gladly explain them all.

LimiTorque will operate all types of valves through any available power source. Your valve manufacturer can furnish them.



Send for the LimiTorque Catalog. Please make request on your business letterhead.

Philadelphia Gear Works, INC.



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Industrial Gears and Speed Reducers
LimiTorque Valve Controls

zinc chromate combined with iron oxides in a suitable vehicle. The second or intermediate coat, consisting of mica flakes in a vehicle of modified phenolic and alkyd resins, is the key to the performance of the new finishing system. The third or final coat screens out ultraviolet light to enhance resistance of the other two coats to corrosive elements and to add to appearance. Tests have shown that the new finish more than doubles the service life of distribution transformer tanks.



COVERS LARGE AREA:

Smoke Alarm System

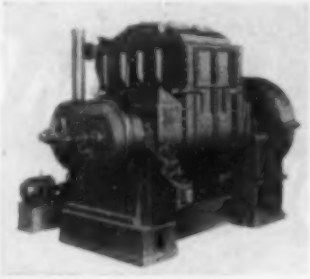
(186A) Following several trial installations, Valley Forge Safe-Eye Alarm Service has put on the market a smoke detection and alarm system which is said to detect smoke in an area up to 200 ft. in length by 30 ft. in width, with a single instrument. The light source projects a beam about the diameter of a lead pencil. This is picked up by a photo cell unit at distances up to 200 ft. away. The latter is claimed to be so sensitive that it will be set off by a good puff of ordinary cigarette smoke. The light source and photo cell each require about 25 watts.

The design is of the fail-safe type, with a 6-volt dry-cell battery alarm standing by to give a warning in case the current supply fails. The alarm may be extended to locations one or more miles distant from the detection unit through arrangements with local telephone companies. Utilizing an invisible infra-red beam, a similar system is available for burglar alarm protection.

FROM SILICONE RUBBER:

Silastic O-Rings

(186B) For hydraulic sealing applications against petroleum oils and most other hydrocarbons, Frederick S. Bacon Laboratories is producing precision O-rings molded from a mixture of silicone rubbers. These rings are made in a limited number of small sizes and are said to be more resistant to deformation under compression than either natural or synthetic rubbers.



MIXES MORE EFFICIENTLY:

Dispersion Mixer

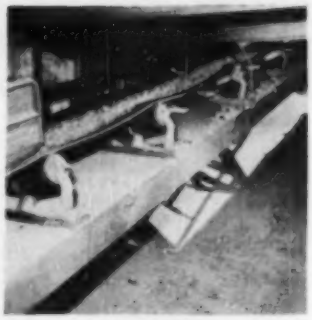
(186C) An addition to its line of Kneadermasters is the new dispersion blade unit offered by Patterson Foundry & Machine Co. This unit is equipped with mixing blades designed especially for color flushing, and is said to flush to a higher pigment concentration, leaving less moisture to be removed under vacuum. The blades add as much as 40 percent to the heat transfer area available. They are said to permit constant and even circulation of the heating medium through fully cored design, special rotary unions and drilled axles. Heat is also provided through the trough and trough heads.

In use, batches of filter press cakes, after being mixed and having initial water decanted, are finish dried under vacuum and increased temperature. The ability to heat batches during this second portion of the process more quickly and evenly is said to contribute to shorter flushing cycles. The mill incorporates improved stuffing boxes which maintain vacuum and eliminate shaft erosion by means of multiple ring packing, lantern glands with constant forced lubrication, and spring loaded followers of improved design.

FOR SMALL DIAMETER LINES:

Pipe Wrapper

(186D) Wrapping machines for the field wrapping of small diameter pipelines with polyethylene-backed adhesive tapes can be handled with the new Pesco Tapester 5 which is distributed by Plastics Engineering. Larger sizes for pipes up to 12 in. in diameter are under development.



HOT MATERIAL BELT

(186E) Reports on dollar savings achieved have been coming in to Owens-Corning Fiberglas Corp. concerning performance of hot materials conveyor belts built of Fiberglas used in conjunction with other reinforcing textile yarns. For example, the installation shown here carries quicklime at 300 deg. F. and is still in good condition after more than 17 months of service. Its average monthly operating cost is $75.50, compared with $188.60 for two cotton belts previously used which gave combined service of only six months, eight days.



LOW POWER NEEDS:

Vibrating Conveyor

(186F) Improved principles in supporting and driving have been incorporated in the new natural-frequency vibrating conveyor developed by Whitley-Carrier Co. The conveyor consists of a steel pan, mounted on springs and vibrated by a motor-driven eccentric. A hydraulic shock absorber is used to give assurance that all the weight of the pan and load is on the springs, not on the eccentric. The conveyor operates at the natural frequency of its springs and true correspondence between conveyor speed and spring characteristics is secured at the factory by adjusting the drive speed for lowest power input. The adjustable pulley is then locked permanently.

Owing to the use of natural frequency vibration, the new conveyor is said to handle at least twice as much material for a given expenditure of horsepower as other vibrating convey-

(*Continued*)

Now—One grease will service all grease applications in the majority of plants



Gives ALL THESE PLANT SAVINGS:

1. **Extends TIME between greasings**—lasts longer . . . stays in bearings longer.
2. **Low-cost application**—fewer servicings and *only the one grease* to handle.
3. **Simple inventory**—Shell Alvania Grease replaces up to 20 brands formerly required.
4. **Better protection**—against heat, cold and moisture.
5. **Greater safety**—less chance of applying the wrong grease!

Gives ALL THESE LUBRICATION ADVANTAGES:

1. **Higher mechanical stability** than any conventional grease at operating temperatures.
2. **Pumpable at low temperatures**—even in unheated storage.
3. **Stable at high temperatures**—superior to the best "soda" greases.
4. **Impervious to water**—excellent resistance to washing out.
5. **Longer service life**—reduced consumption.

The "MILLION-STROKE" Industrial Grease!

A grease that will stand 100,000 punishing strokes of the ASTM Work Tester has been considered a superior lubricant.

In a deliberate attempt to break down Shell Alvania Grease, *on the same tester* the run was extended . . . 200,000 strokes . . . 300,000 strokes . . . 500,000 strokes! Finally, at one million strokes the test was discontinued, because this grease *would not break down*—it was still a fit lubricant both in appearance and consistency.

SHELL OIL COMPANY

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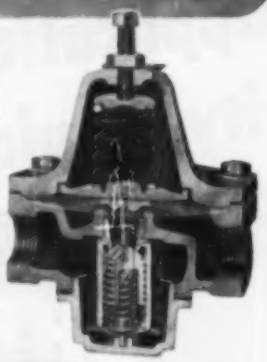
SHELL

SHELL ALVANIA . . . The "MILLION STROKE" Grease

stopping
ONE HEADACHE...

Once you have chosen Cash-Acme valves as component parts of your factory equipment, you can stop worrying about valve failures or sudden disaster.

We invite you to investigate Cash-Acme direct acting single seated pressure reducing valves for steam . . . water . . . air . . . or gas lines.



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Automatic Valves

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Your Newest Problem . . .
Air Pollution

Be alert to new ordinances governing the by-products of your factory processes. Use factual wind data in developing your plans for smoke and fume abatement. Bendix-Friez wind equipment, made by the manufacturer of the world's foremost meteorological instruments, is indispensable in studying the factors relating to your smoke and fuel control.



FRIEZ INSTRUMENT DIVISION
OF BENDIX AVIATION CORPORATION
Baltimore 4, Maryland

ors. It is claimed not to slow down or "dampen" under load and is said to handle 25 tons horizontally per hr. over 10 ft. of conveyor length for each ½ hp. Because smaller motors can thus be used and construction can be lighter, a conveyor for a given load is said to cost less. Available sizes range from 6 to 48 in. in width and from 5 to 200 ft. in length. Only one motor drive is required for each 150 ft. of length. The manufacturer has applied the same principle to spiral elevating conveyors in sizes up to 30 tons per hr.

Improved Work Glove

(188A) An all-purpose work glove with a wing-type "Dura-Thumb" has been announced by Richmond Glove Corp. The chrome-tanned leather palm and thumb are continuous, without a seam, making for a stronger and more flexible construction. These gloves come with either a 4½-in. gauntlet or a 2½-in. safety cuff.

Caustic Soda Meter

(188B) For handling caustic soda solutions Fischer & Porter is now producing an all-nickel rotameter provided with a nickel metering tube and a steam jacket around the liquid passages. Movement of the metering float is picked up by a magnetic follower and transmitted as air pressure to a recorder. A recorder-controller is also available. Metering capacities of the various sizes produced range from ½ to 300 gpm.

Joint Sealing Compound

(188C) Highside Chemicals Co. is offering Leak Lock, a new sealing compound for threaded joints and gasket surfaces. This material sets up about three times as fast as other non-brittle joint sealing compounds and does not become hard or brittle. It is said to remain plastic enough to permit easy disassembly. A poly-hydroxlated plastic base material is used, for resistance to a wide range of chemicals and solvents.

Belt Repair System

(188D) Magic Vulc is the name of a new system of equipment and plastic rubber now being offered by Magic Chemical Co. for the protection and repair of worn conveyor belts. The system employs an anti-abrasion rubber coating, primer and suitable equipment, and can be applied, it is claimed, by any unskilled workman. The same material can be used in

coating valves, pipes, fittings and chutes.

Slewing-Arm Crane

(189A) Towmotor Corp. is now producing a crane arm attachment for fork trucks which attaches between the forks and is pivoted so that a hydraulic cylinder can swing it 20 deg. either side of the center. It can handle up to 800 lb. at 80 in. load center.

Nylon Diaphragm Pump

(189B) For unloading 15 to 55 gal. drums Bishman Mfg. Co. is now offering a pump equipped with a nylon cord, synthetic coated diaphragm that is resistant to many organic liquids. The pump is self-priming, handles 7 gpm., has a vapor-proof, non-drip valve, and is designed to drain completely after use by lifting the handle to the top of the stroke.

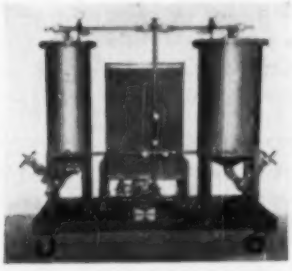
Magnetic Pipe Trap

(189C) Columbia Engineering Service Co. has introduced an industrial size magnetic trap for pipelines, available in sizes from 1½ to 4 in. IPS. The device removes ferrous contamination from liquids, employing powerful permanent magnets.

Nickel-Clad Wire

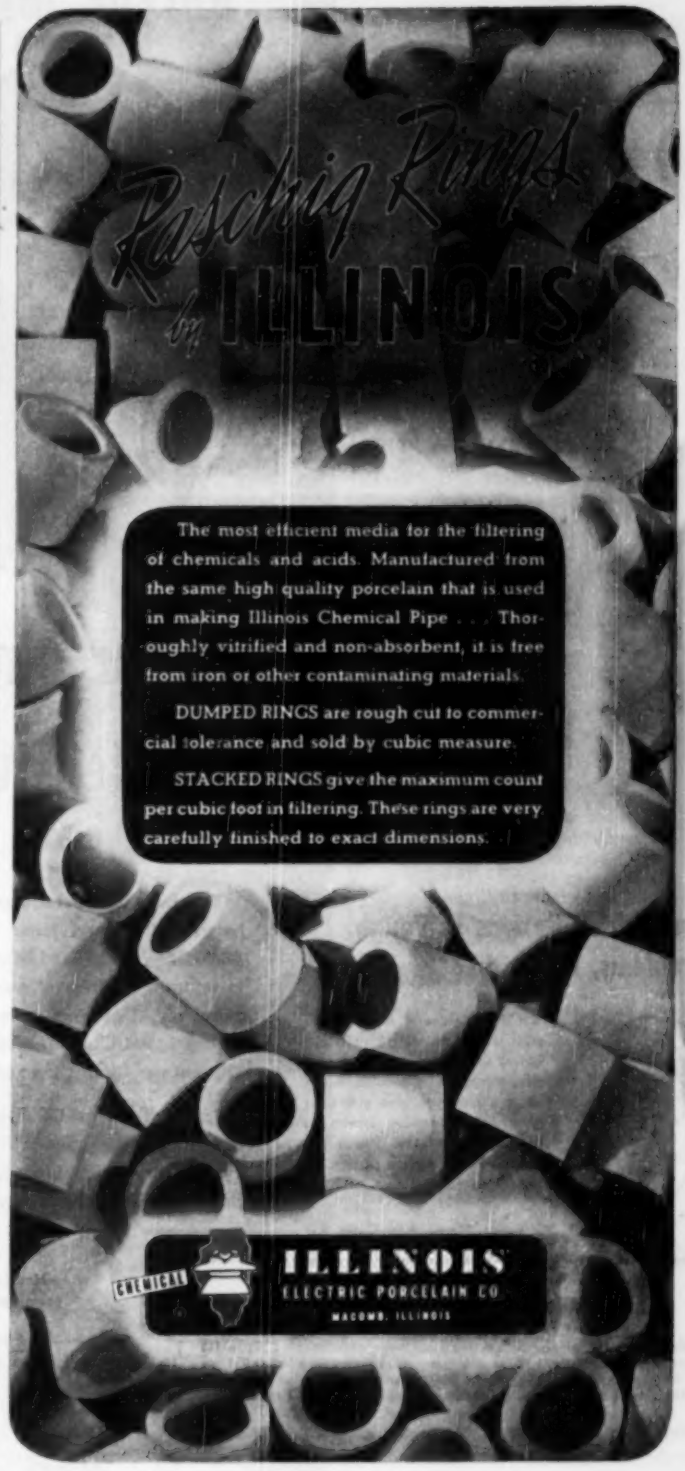
(189D) Nickel-clad copper wire, rod, and flat wire are now available from Alloy Metal Wire Co. Approximately one-third of the cross-sectional area is nickel around a copper core. The composite is produced by inserting a copper rod in a nickel tube and drawing down to any size

(Continued)



FLEXIBLE FILTER UNIT

(189E) Shown above is a special filter unit produced by Titeflex, Inc. Constructed of 316 stainless steel, it contains one filter chamber of 10 sq.ft. and one of 20 sq.ft. area, in conjunction with a precoat tank. Thus filter capacity of 30, 20 or 10 sq.ft. can be obtained from the same unit, to give peak efficiency whether batch sizes are large or small.



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with the
FEED



TYPE 149

Ample Power for Direct Action ...Easily Adapted to Remote Control

For Quick Solutions of Tough Problems, Count on *Climax!*



You'll be amazed at the ease with which a BS&B Controls Engineer can end your control worries. Strategically located, he is always ready to give you complete, understanding service... in strict confidence. Check the coupon below for the BS&B Controls Man nearest you.

You have a leverage ratio of 18 to 1 forming the connection between float and inner valve plug in the valve body of the BS&B-Climax 149 Feed Water Regulator. This means ample power to operate against differentials across the valve as usually encountered. Designed to serve as Feed Water Regulator or as Liquid Level Control. Combines the economy with the proved efficiency of Climax top-and-bottom-guided, reversible valve bodies.

Employ the type 149 float cage for direct control of level, remote of valves or instruments through air pilots, and operation of alarm systems or signals through Mercoid switches. Yes, sir... you can't beat this BS&B-Climax Control for versatility!

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Models available... in high tensile cast iron for pressures up to 250 psi, cast steel for up to 500 psi.

Complete description, diagrams, specifications and applications are ready for you. Mail the coupon... today!

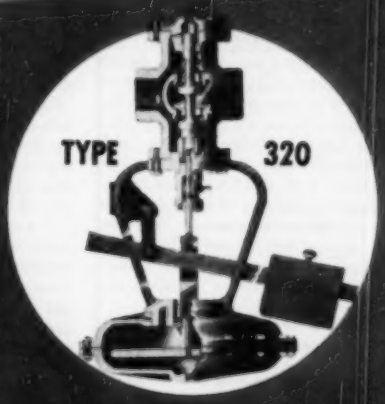
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Efficiency at a Real Saving

New BS&B Climax WATER REGULATOR

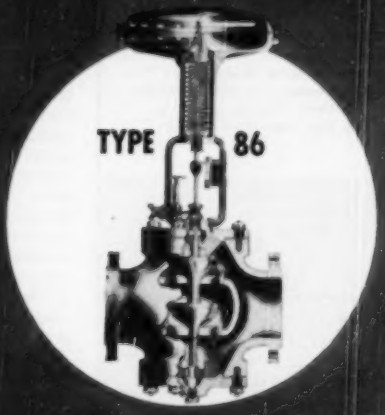
PRESSURE REDUCTION OR BACK PRESSURE REGULATOR

Type 320 Regulators allow sensitive pressure control in vapor-vacuum and low-pressure steam heating systems. Weight loaded, pressure operated, diaphragm actuated. Built for long life under rugged conditions.



DIAPHRAGM CONTROL VALVE

Type 86...famous the world over for high lift, accurate control, ease of maintenance. Fully reversible in the field. Super-polished lower stem for minimum friction. Wide rangeability. Check coupon for catalog.



DISPLACEMENT LIQUID LEVEL CONTROLLERS

No leakage... no stuffing box... no friction problem! That's the Type 850, a BS&B-Climax-developed exclusive. Ideal wherever liquid level control involves exacting and wide range control. Shown here with Type 1410 BS&B-Climax Control Pilot. Complete catalog available... send coupon now.



from ¼ to 0.002 in. diameter. Main uses are expected to be for carrying electricity at high temperature, with good electrical conductivity and high resistance to oxidation.

Saran-Lined Valve

(191A) Dow Chemical has now made available Saran-lined diaphragm valves of the Grinnell-Saunders type for corrosive liquids and gases. Valves are lined with Saran and ordinarily use Saran-rubber diaphragms, but diaphragms of other materials can be supplied optionally. Sizes range from 1 to 6 in. The valves are handled by Saran-Lined Pipe Co.

Temperature Indicators

(191B) Tempil Corp. has extended its line of temperature measuring materials. Tempilaq is now available in 50-deg. F. steps from 1,650 to 1,950 deg. F., supplementing the previously available compositions beginning with 113 deg. F. Tempil pellets, formerly available from 113 deg. to 2,000 deg. F., are now made also in 50-deg. steps from 2,000 to 2,500 deg. F., as well as in a new composition for strongly reducing atmospheres.

Meter Adapter

(191C) Fischer & Porter's latest development is an adapter for installing rotameters in horizontal process piping. The adapter, installed where desired on all standard meters, gives in-line piping connections and eliminates need for vertical piping runs as would ordinarily be used.

Unbreakable Bucket

(191D) Enrup, a tough new thermosetting blend of plastic and rubber, is being used by U. S. Rubber to make unbreakable buckets for carrying corrosive chemicals. Most acids, alkalis, and aliphatic solvents can be handled at temperatures up to 150 deg. F.

Acid Container

(191E) Using surplus wartime oxygen tanks, Texas Railway Equipment Co. has developed a modification for use as a shipping container. The 8½-gal. tank is of stainless steel and has a special vent valve that eliminates need for a tilter or pouring spout. One end is recessed to provide a seat on which to stand the container. The manufacturer anticipates a service life of 15 years under reasonable shipping care. —*End.*

New Products and Materials

JOSEPH A. O'CONNOR, News Editor

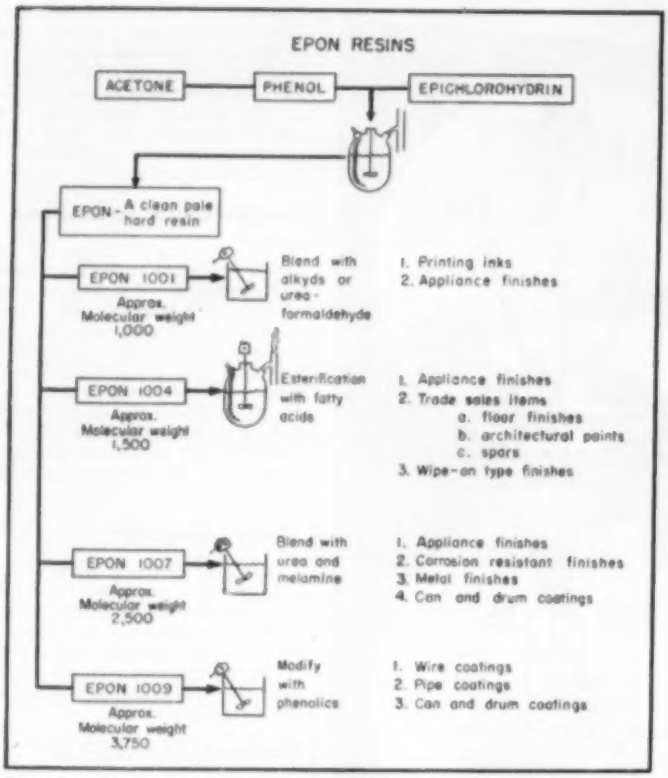


Chart above shows raw materials, preparation and suggested uses for new class of resins.

Many of the Properties You Want In One Basically New Type of Resin

Shell Chemical's EPON series has high hopes for coatings, linings, finishes and other heavy duty applications

(192A) Three important properties in one resin—chemical resistance, adhesion, and flexibility—have given Houston, Tex., and Shell Chemical Corp. a new plant, ready to go this month. The raw materials going into the installation are epichlorohydrin, acetone and phenol. The product coming out: a new class of condensation polymer with ether linkages between carbons and relatively wide distances between the functional groups.

The ether bond is responsible for excellent resistance to soaps and detergents and a degree of chemical inertness that permits such things as 16 months continuous operation in corrosive acids of an anodizing tank at G.M.'s Inland Manufacturing Division. The tank coating, inside and out, held up against 25 percent sulphuric at temperatures as high as 210 deg. F.

The wide spacing along the chain of the reactive hydroxyl and epoxide groups gives rise to a degree of flexibility that permits their use in can, drum, crown and cap coatings where the metal is rolled and crimped after it is coated. At the same time the new class of resins is able to boast the property of extreme hardness.

For example, a finish containing 70 parts of EPON 1007 (one of four grades—1001, 1004, 1007, 1009—of the resin being marketed by the company) and 30 parts of a commercial urea-formaldehyde resin pigmented at a ratio of 1:1 and baked for 15 min. at 400 deg. F. withstands a complete bend over a conical mandrel without any sign of failure. This same finish withstands both a 28 in.-lb. direct bump and reverse bump on a Gardner impact tester.

You can chalk the adhesive qualities of the molecule up to its polar nature. Finishes based on the resins give outstanding adhesion over wood and metal surfaces even without the customary priming or chemical pretreatment. A simple cleaning or sanding operation is sufficient, eliminating the expense of a priming coat and the necessity for complicated cleaning equipment.

The resins may be used in surface coatings either in the unmodified form or modified with various fatty acids. If drying oil fatty acids such as linseed, dehydrated castor or soya are used, the resulting vehicle may be air-dried, and in this form, act as the basis for floor varnishes, spar varnishes, and other trade sales items. If slow or non-drying fatty acids are used, the ester may be used in baking enamels in combination with melamine or urea-formaldehyde resins.

The unmodified resins are generally used in baking finishes and in this application they are cold cut in a suitable solvent and mixed with a resin which will react with the hydroxl and epoxide groups cross linking the polymer. Urea-formaldehyde, melamine-formaldehyde, and certain phenol-formaldehyde resins may be used to cure the EPON resin.

A word about the four types of the resin: EPON 1001, the lowest molecular weight grade of the surface coating resins currently available, is most useful in applications requiring the greatest degree of solubility and compatibility with other resins and oils. A typical application involves its use to improve the adhesion, chemical resistance, and flexibility of alkyd-melamine blends.

EPON 1004 is the most widely used of the four in the preparation of cooked vehicles. Since the resins may be regarded as resinous polyhydric alcohols, 1004 can be esterified with fatty acids, rosin or other resin acids, tall oil, or mixtures of these with limited amounts of dibasic acids, for example, phthalic anhydride. Typical applications include appliance finishes, toy enamels, drum and can linings, industrial maintenance coatings, and spar and floor varnishes.

1007 is most widely used in unmodified or cold-blended formulations where it is cured by reaction with small amounts of urea or melamine-formaldehyde resins, or heat-convertible phenolics. This type of formulation offers the ultimate in chemical resistance, solvent resistance, hardness and adhesion because the resin is least extended, or diluted, with other materials. Modification of the resin with fatty acids introduces ester linkages with their limited resistance to hydrolysis and saponification. Typical applications of the resin include can coatings, drum linings, toy enamels, finishes for die castings, and primers, as well as finishes for washing machines and other appliances.

Since EPON 1009 is the highest molecular weight member in the current series, it offers rapid cure, extreme chemical resistance, and excellent flexibility. Another outstanding feature is the unusual heat resistance. Accompanying the higher molecular weight is the unavoidable decrease in compatibility and solvency.

Typical uses include chemical processing equipment, heat resistant coatings, wire enamels, soft drink container liners, and similar applications requiring unusual chemical resistance.

NEW INTERMEDIATE:

Acetovanillone

(193A) A process for the manufacture of Acetovanillone (3-methoxy, 4-hydroxy acetophenone) has been developed by Marathon Corp. This compound is now available in pilot plant quantities.

Attractive possibilities for its use as an intermediate in the synthesis of pharmaceuticals, food preservatives, fungicides, antioxidants and other organic compounds are indicated.

Acetovanillone's high absorption of ultraviolet light, up to 3,050 Angstrom units, suggests its possible use as a sunscreening agent.

INTRAVENOUS:

Terramycin

(193B) An injectable form of terramycin has been made available to the medical profession by Chas. Pfizer and Co., Inc. Terramycin Intravenous, the name under which this new dosage form will be marketed, will be especially valuable for treatment where immediate therapeutic action is essential. The new intravenous form should prove effective in the treatment of many severe diseases and infections which are rapidly producing tissue destruction. It will be useful in the treatment of hospitalized patients who cannot take the customary forms of oral antibiotic medication.

NEW TYPE:

Acid Inhibitor

(193C) A pickling inhibitor that offers high inhibiting action in many types of mineral acids including hydrochloric, sulphuric and phosphoric acids, lack of odor, complete miscibility with pickling solutions, ease of handling and economy of use is now being sold by Enthone Inc.

(Continued)

More Information . . .

To find out more about any of these new products, circle the item's number on Reader Service Postcard inside the back cover.

This Month . . .

The acid inhibitor described on p. 193 will not cause hydrogen embrittlement of steel . . . This month's debutante in metals is vanadium, look for increased use . . . Look's like the medical profession is going in for ion-exchange resins in a big way. See p. 196 . . . Water soluble sodium cellulose sulphate promises to find more uses than a safety pin. Bottom of p. 198 for this one . . . And on p. 200 there's interesting reading about metal enamels and primers that may be applied right over rusty surfaces and promise to put the quietus on further rusting . . . Lastly, for a slick lacquer process have a glance at 202.

Next Month . . .

Man-sized lubricants that you can really put the heat on, and that stand up equally well under extremes of pressure will be announced . . . We'll also have word of a textile finish with pretty substantial properties . . . A new chemical to rival the anti-histiminics will appear here too. Don't miss it.



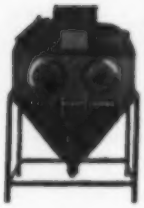
FIREPROOFING COMPOUND

(193D) **No danger of clothing fires here. The fabric worn by these men has been permanently fireproofed by treating it with Pernaproof 300, a liquid dispersion of Geon latex marketed by Treesdale Laboratories, Inc. The materials are flame resistant, even after repeated launderings in which any soap or detergent may be used.**

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These inexpensive, ready-to-use Blast Cleaning and Dust Collecting units earn you extra profits where custom-built equipment is not practical.



BLAST CLEANING CABINET
cleans metal parts, removes rust, scale, grime, dirt, paint, etc., in a few seconds. Ideal unit for producing clean, smooth surface on pieces up to 60" x 36".

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$315.00 and UP



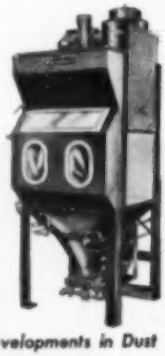
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for maintenance and many other uses including the removal of rust, dirt, scale, etc. Economically cleans large objects such as tanks, bridges, structural work preparatory to painting. Six sizes, stationary or portable.

BLAST CLEANING MACHINES
$170.00 and UP



UNIT DUST COLLECTOR
traps dust at its source, minimizes machine breakdowns, reduces housekeeping and maintenance costs. Solves many grinding and polishing nuisances and material losses.

UNIT DUST COLLECTORS
$286.00 and UP



HYDRO-FINISH CABINET
uses liquid blast, eliminating dust, and reduces costly hand polishing, cleaning and finishing of molds, dies, tools, etc. Removes scale, discoloration and directional grinding lines, prepares surfaces for plating and coating. Holds tolerances to .0001".

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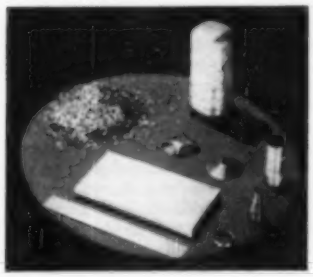
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NEW PRODUCTS, cont. . .

The action of the inhibitor in such acids as hydrochloric and sulphuric is of the order of 99 percent at temperatures up to 180 deg. F. In addition to the high inhibiting action with its attendant advantages for saving of acid, lowering attack on metal, and brighter pickling, the inhibitor lowers the surface tension of the pickling solution. This results in smaller pendant drops and a lesser degree of acid films remaining after pickling. Thus, according to the manufacturer, drag-out is lowered 10 to 30 percent. This saving is important because less acid is dragged into the lime solution than is otherwise required to neutralize the acid. This results in a lower amount of calcium sulphate forming on the work. Calcium sulphate usually contributes to rusting and lowering the lubricating qualities of the lime.



MAKES ITS BID:

Vanadium

(194A) A high-purity, ductile vanadium metal is now available in limited quantities for fabrication and use by the metal industry according to an announcement by the Electro Metallurgical Division of Union Carbide and Carbon Corp. The metal averages above 99.8 percent vanadium and can be obtained in the form of ingots, plates, bars, sheet, and foil. It is also available in the form of chips for remelting into ingots of special sizes and shapes (see cut).

Pure vanadium has good corrosion resistance, high tensile strength and excellent ductility. It is highly resistant to corrosion by salt spray, sea water and reducing acids in moderate concentrations, and tests to date indicate that it has good anti-fouling characteristics.

Vanadium metal has a modulus of elasticity of about 22 million psi. and a density of 6.1. The modulus-density ratio for vanadium is practically the same as that for steel (3.7 million), although the density of vanadium is appreciably lower than that of steel. This compares with a modulus-density

ratio for titanium variously given as 3.1 to 3.6 million. From this, it can be seen that vanadium metal has a very favorable strength-weight ratio.

The high modulus-weight ratio of vanadium metal suggests its use for structural parts in which flexural rigidity is the important factor. Its high strength, combined with its resistance to salt water, suggests its use for instrument parts subjected to high dynamic stress in marine atmospheres. The metal also has good static tensile properties which should make it suitable as a spring material.

As yet, there has not been time for the engineers and men who design products to use and apply vanadium metal to any great extent. However the metal has the two prime requisites for a structural material: good mechanical and chemical stability. Perhaps these characteristics will be enough to offset its high cost ($30 per lb.) and enable the metal to compete on a larger-volume-lower-cost basis.

TOUCH:

Coating

(195A) Commercial production of a tough plastic coating for wood surfaces which is resistant to chemicals and solvents, even acetone, but at the same time has outstanding properties of hardness and flexibility, has been revealed by U. S. Industrial Chemicals, Inc.

A true plastic finish of the thermosetting phenolic type, which dries at room temperature, the material is unharmed by burning alcohol and is not marred by nail polish.

The material, a modification of a French product known as Pyrolit, is as quick drying as shellac, and is especially recommended for use on floors because of its resistance to wear, abrasion, rubber burns and water marks.

The basic material in the product is similar to the phenolic molding resins used in producing electrical outlets such as floor plugs and sockets and other industrial equipment. It differs from conventional paints, varnishes and lacquers in that it contains no drying oils or nitrocellulose.

It is a thermosetting product which cures or dries by condensation and polymerization at room temperatures, the chemical reaction being induced by the addition of a catalyst or hardener prior to use. The incorporation of the hardener in the base solution involves the simple procedure of blending and stirring.

Spokesmen for the company said that the coatings are approximately

(Continued)

METAL PLANT
owner estimates savings of $7690 per year with Pangborn Dust Control.

ASBESTOS PRODUCER
reports profit of $20 a day with Pangborn Dust Control.

FOOD PROCESSOR
writes Pangborn Dust Control saves him $3048 per year.

CARBON PRODUCER
reports $1471 yearly profit with Pangborn Dust Control.

CHEMICAL MFGR.
states Pangborn Dust Control saves him $14,859 a year.

FEED MILLER
reports approximately $50 saved each day with Pangborn Dust Control.

WOOD FABRICATOR
estimates $875 saved every year with Pangborn Dust Control.

REFRACTORY
executive reports savings of $4318 per year with Pangborn Dust Control.

RUBBER PLANT
owner reports $100 profit each month with Pangborn Dust Control.

CHARCOAL MFGR.
estimates yearly saving of $13,900 with Pangborn Dust Control.

WHICH DUST PROBLEM BOTHERS YOU ?



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As these authentic cases from Pangborn's files show, Pangborn Dust Control stops dust at a profit! Even where dust can't be sold or re-used, Pangborn users report impressive savings from $1200 to $7000 and more a year.

And where dust is valuable (made up of products or raw materials), annual savings of $12,000, $13,000 or $14,000 a year are not uncommon for Pangborn installations.

FIND OUT HOW MUCH YOU CAN SAVE! A Pangborn Dust Survey costs nothing—but will show you how you can *turn the dust in your plant* into cash savings. For details, write the PANGBORN CORPORATION, 2600 Pangborn Blvd., Hagerstown, Maryland.

Look to Pangborn for the latest developments in Dust Control and Blast Cleaning Equipment.

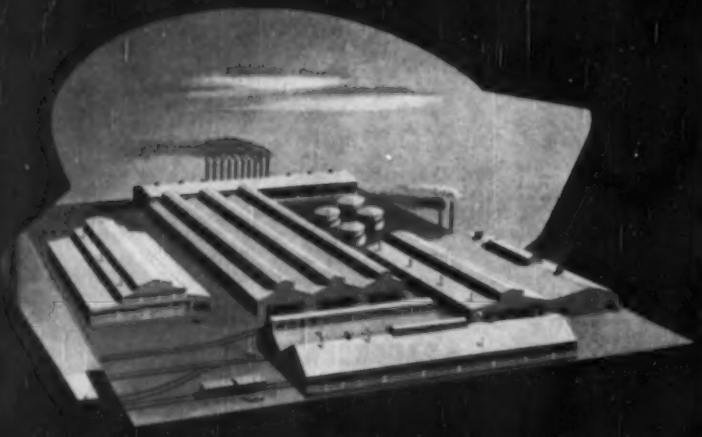


STOP the DUST HOG from stealing profits with

Pangborn

DUST CONTROL

You save on original investment with McCloskey function-engineered plants



Your original investment is less with McCloskey function-engineered plants because the methods and designs developed by McCloskey engineers over a period of years eliminate many time-consuming operations. The use of our exclusive Rigidsteel* frame eliminates costly truss fabrication—gives you more headroom.

You save on complete service too for McCloskey works with your personnel, gives you custom designs, supplies all foundations and materials, and supervises construction. Your requirements are quickly transformed into reality by McCloskey.

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Before you plan your expansion program learn how McCloskey function-engineered plants and buildings will give you the most for a low initial investment. You will be pleased with our efficient service. Write McCloskey Company of Pittsburgh, 3411 Liberty Avenue, Pittsburgh 1, Pa.

**Rigidsteel is the trademark of the McCloskey Company of Pittsburgh*

McCloskey Company of Pittsburgh

two-thirds as hard as glass. It is not possible to pierce the coating with a finger nail, and it is practically impossible to penetrate the film with a coin or similar hard objects. At the same time, the film is sufficiently flexible that when extreme pressure is exerted with a hard object, the wood may be dented but the film remains unbroken.

SAVINGS AND CONVENIENCE:

Formaldehyde in Alcohols

(196A) Solutions of formaldehyde in various types of alcohols are being made available to general industry for the first time on record by the Celanese Corp. of America. Known as Formcel, the new product is now being sold in semi-works quantities at 55 percent solutions of formaldehyde in methanol and 40 percent solutions in butanol, propanol and methanol.

Tests have proved the practicability of handling a relatively water free alcohol solution of formaldehyde at regular temperatures in standard equipment.

Cost savings and convenience of handling make Formcel attractive.

THERAPEUTIC:

Ion Exchange Resins

(196B) If your family doctor prescribes a resin for your stomach ulcers don't cast a jaunticed eye on the old gentleman. He hasn't wandered off the reservation. Sterling-Winthrop has turned up information on ion-exchange resins reporting that long-time research has indicated their value in the treatment of heart conditions, high blood pressure and similar complaints requiring salt-free diets. The same resins also help remove excess stomach acids to relieve pain in gastric ulcers.

Dr. Maurice L. Tainter, chief researcher on the project, defined ion-exchange resins as "insoluble materials which have the property of exchanging one chemical entity (an ion) for another. Where a specific ion is deleterious or objectionable in certain diseases or conditions, there is the possibility of using a resin to substitute other ions for the one objectionable."

Swallowed before meals these resins remove most of the sodium from salted foods which may be bad in some heart conditions. Too much sodium in the body leads to watery swellings, or dropsy.

Extensive trials of the resins have been made with "encouraging results" on both animals and human patients.

(Continued)

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SYNTHESIS OF OTHER CHEMICALS

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2. **Nitro-olefins**—treatment of nitroesters with sodium carbonate (see above) or condensing primary NP's with aromatic aldehydes.
3. **Nitroamines**—from NP's, formaldehyde, and amines by Mannich reaction.
4. **Diamines**—(a) reduction of nitroamines (see above), and (b) reduction of dinitroparaffins made by condensing nitroparaffins with ketones, or reacting chloronitroparaffins with alkali salt of an NP.
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9. **Trialkyl Isoxazoles**—hydrolysis of Beta-Dioximes (see above).
10. **N-Alkyl Hydroxylamines**—mild reduction of primary NP's.
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Methanol • Amines • Nitroparaffins • Crystalline Riboflavin

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GIVES FULL DATA ON CORROSION RESISTING STAINLESS STEEL VALVES, FITTINGS, ACCESSORIES



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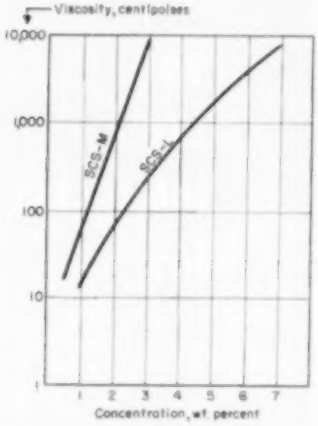
Penicillin Plus

(198A) National release of Pentresamide tablets, a combination of potassium penicillin G with the three most soluble, least toxic systemic sulfonamides, sulfamerazine, sulfadiazine and sulfamethazine, has been made known by Sharp and Dohme, Inc.

Designed for simultaneous treatment of infections where oral administration of penicillin and the sulfonamides is indicated, the drug is effective against a wider range of organisms than either sulfonamides or penicillin alone. By shortening the period of treatment and obtaining results with smaller total dosage toxicity is minimized and the danger of developing bacterial resistance is lessened.

The three sulfonamides are combined in Pentrasamide for effective treatment with marked dimunition of renal complications. Since each of these compounds dissolves independently, crystalluria is prevented or markedly diminished without decreasing the actual quantity of the sulfonamides.

Absorption is more complete and excretion more rapid.



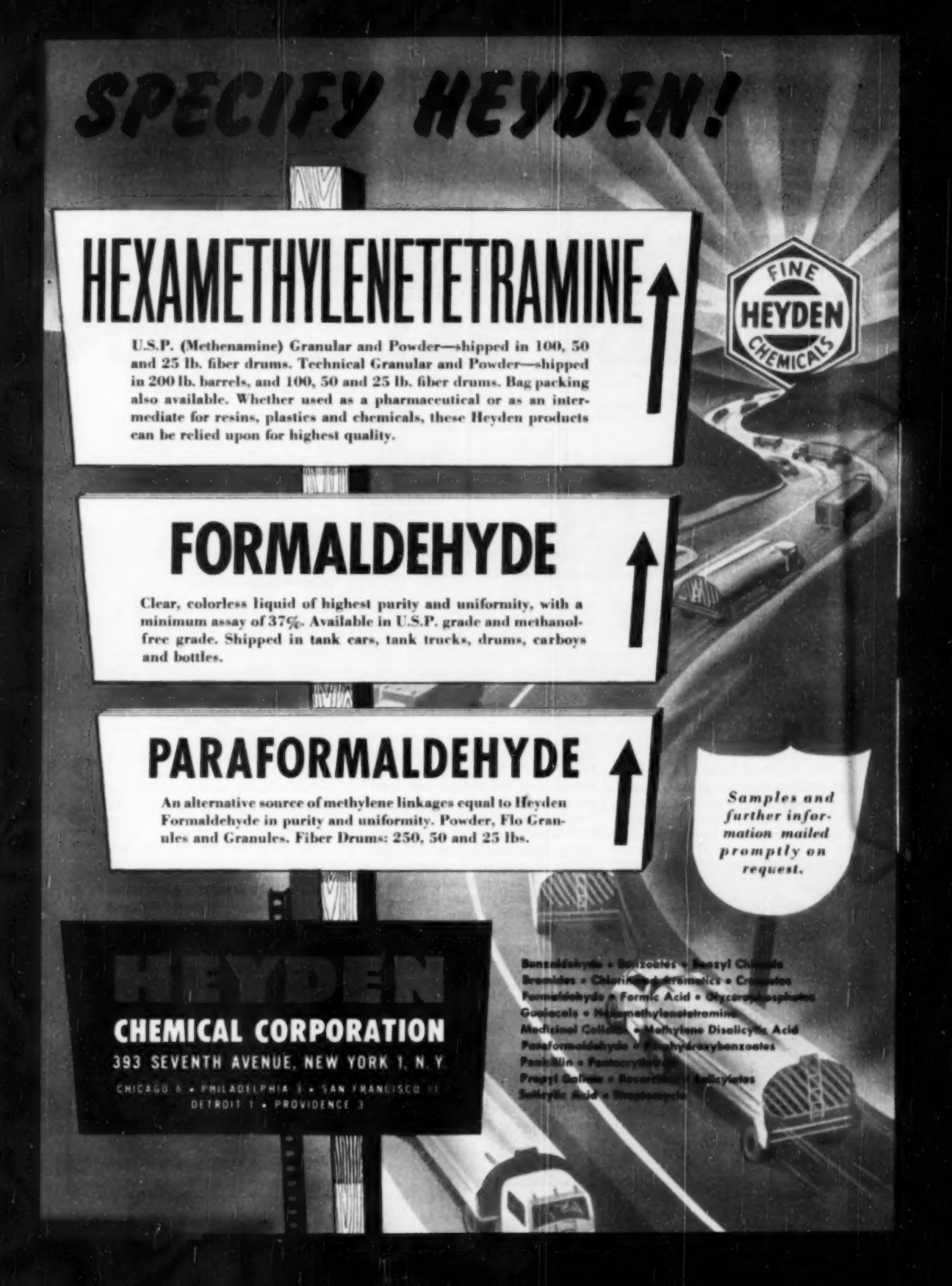
High viscosities of SCS solutions offer unique applications in differing fields.

WATER SOLUBLE:

Sodium Cellulose Sulphate

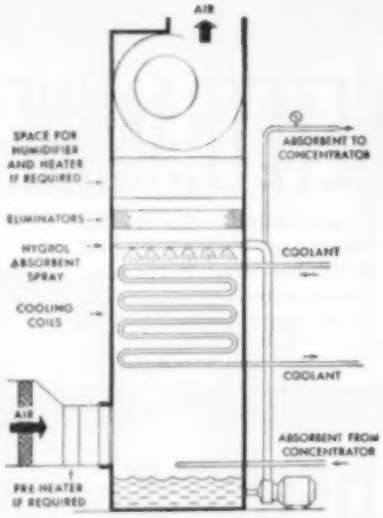
(198B) You can credit a water soluble cellulosic, sodium cellulose sulphate, to Tennessee Eastman. As the name implies, SCS is the sodium salt of cellulose acid sulphate. The sulphate groups are attached to the cellulose chain by ester type linkages, and

(Continued)


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Clear, colorless liquid of highest purity and uniformity, with a minimum assay of 37%. Available in U.S.P. grade and methanol-free grade. Shipped in tank cars, tank trucks, drums, carboys and bottles.
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Propyl Gallate • Resorcinol • Salicylates
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New Method Gives Precise Control in Air Conditioning

Niagara "Controlled Humidity Method" Uses Hygrol, Hygienic Liquid Absorbent

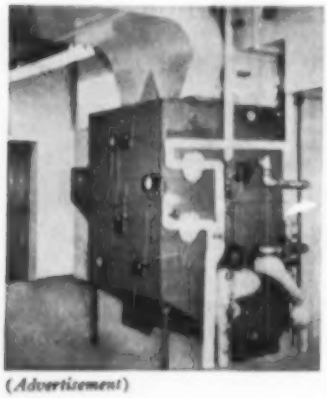


NIAGARA CONTROLLED HUMIDITY METHOD — FLOW DIAGRAM

● The Niagara "Controlled Humidity Method" is a new system of air conditioning giving complete control of temperature and relative humidity, holding constant conditions or varying them at the will of the user. Especially, it provides dry air at normal atmospheric temperatures with little or no refrigeration required. A condition of 15 grains of moisture per pound of air at 85 deg. F. dry bulb temperature has been produced without refrigeration.

The apparatus is enclosed in a casing thru which the air is drawn by fans. The air is filtered and then enters a chamber where it is dehumidified in passing thru a spray of "Hygrol" Liquid (a hygienic hygroscopic chemical that absorbs the air-borne moisture and contains no salts or solids to precipitate). In the same chamber are located cooling coils which remove the latent heat of evaporation and also sensible heat as required.

The absorbent liquid spray falls into a tank at the base, where it is piped to a concentrator, removing moisture taken from the air. The re-concentrated liquid returns to the system. This process is continuous, and the apparatus operates at full capacity at all times.



The same equipment may be used to provide winter air conditioning when required, by installing a tempering coil at the outdoor intake, an humidifier, and a reheat coil above the eliminators.

This equipment is manufactured in a range of sizes providing from 1000 to 20,000 CFM of conditioned air from a single unit, and mutiple unit installations are practical. It is expected that, by reducing the need for refrigeration, the cost of air conditioning will be reduced by this method. Applications generally are in a temperature range from 35 deg. F. upward. Below the freezing temperature of water, the Niagara "No-Frost" method is applicable.

The equipment is protected by U. S. and foreign patents. Installations have been made in food and chemical process industries, in packaging hygroscopic products, for preventing condensation of moisture on metals and other products in storage, in air conditioning for laboratory control and for human comfort.

For further information, write Niagara Blower Company, Dept. CE, 405 Lexington Ave., New York 17, N. Y.

(*Advertisement*)

NEW PRODUCTS, cont. . .

there is approximately one sulphate group per three anhydroglucose units. Made by treating cellulose fibers like wood pulps or cotton linters with sulphuric acid and other reagents, the resulting granular product dissolves in either hot or cold water.

Adding SCS to water increases the viscosity of the solution rapidly. Available in two viscosity types, medium and low, the former lies in the viscosity range of 300-1,000 centipoises and the latter in the range of 20-70 centipoises, both in 2 percent water solution at 20 deg. C. If a solution containing 2 to 3 percent of the material is distributed evenly over a smooth plate and the water present removed by evaporation, the result is a clear, strong, grease-proof, non-burning film.

Initial screening tests indicate that the cellulosic is completely non-toxic and long range feeding experiments are now under way.

Application of SCS in the paper industry, in packaging, detergents, water and emulsion paints, textiles, foods, drugs and cosmetics is predicted by the manufacturer.

ANTISEPTIC:

Hexachlorophene

(200A) A new chlorinated diphenyl methane compound, is being used by the West Disinfecting Co. in an antiseptic liquid hand soap. It is expected that use of the chemical in the soap will remove a high percentage of micro-organisms. This, in turn, will help reduce the possibility of respiratory or intestinal infections transmitted by food handlers. In a two-week test of the soap it was found that after 16 hours' use there was a 53.5 percent reduction in resident bacteria; after four days, a 91.5 percent cut; after 11 days, a slash of 96.5 percent (see cut).

The hexachlorophene in this new soap also helps to protect hands from skin lesions and secondary infections resulting from minor injuries. This, as the manufacturer suggests, makes it desirable for use in the factory.

PAINTS OVER RUST:

Metal Enamels and Primers

(200B) Development of a new group of products to paint rusty interior and exterior metal surfaces without extensive sandblasting and other costly cleaning methods is announced by the McCormack-Medl Corp.

These new products, trade-marked Rustorize, consist of a special metal

(*Continued*)

MISSION MANUFACTURING CO.

Streamlined Flo

PUMPS...LAST LONGER!

CONVENTIONAL CASING DESIGN. Turbulence caused by cut water of conventional casing design accelerates corrosion and erosion.



MISSION CONCENTRIC CASING permits Streamlined Flow which converts velocity into pressure without losses due to turbulence.



Service records in these industries:

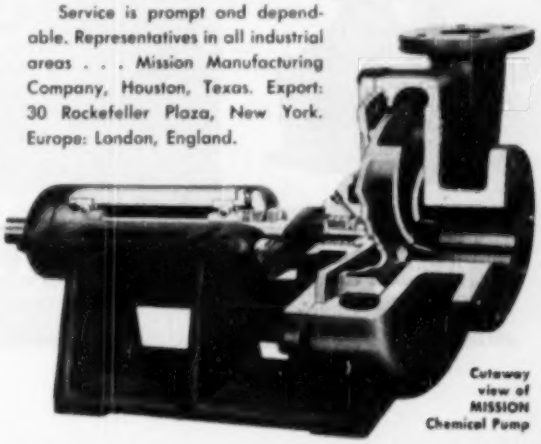
Heavy Chemicals	Oil Well Drilling	Irrigation	Sugar Refining
Light Chemicals	Oil Production	Cement	Pulp & Paper
Ore Processing	Oil Refining	Mining	Carbon Black
Metal Processing	Food Processing	Marine	Naval Stores

. . . have ***proved*** that the MISSION Streamlined-Flow Pump far outlasts others in severe services. This pump has proved a real champion for handling slurries, acids, all abrasives and corrosive fluids.

This long life is due to ***Streamlined Flow in Concentric Casing***, with Semi-Open-Type Impeller and extra-large, non-clogging fluid passages. These features give smooth, unimpeded flow of the fluid pumped. By eliminating the cut water of conventional-type casing, the Streamlined-Flow design minimizes turbulence, cavitation, corrosion and erosion.

High interchangeability of parts. Only 3 pedestal sizes. Casing sizes, 1" to 6" discharge; capacities up to 1800 GPM; heads up to 350 feet; speeds up to 3500 RPM.

Service is prompt and dependable. Representatives in all industrial areas . . . Mission Manufacturing Company, Houston, Texas. Export: 30 Rockefeller Plaza, New York. Europe: London, England.



Cutaway view of MISSION Chemical Pump

MAIL THIS COUPON FOR CATALOG

MISSION MANUFACTURING COMPANY, Div. CP,
P. O. Box 4209, Houston, Texas

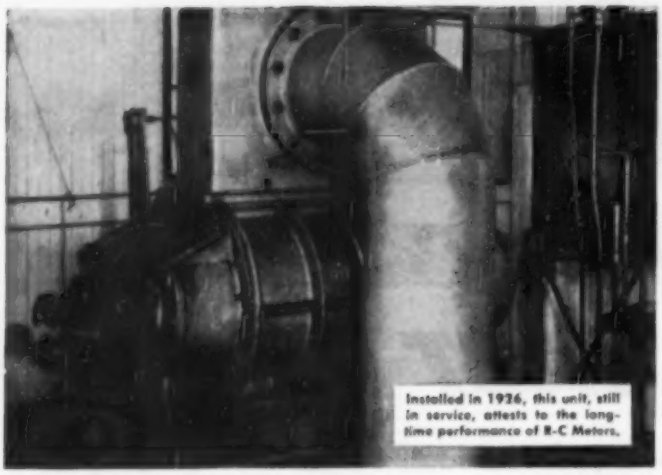
Please mail me, without obligation, your new catalog on MISSION Centrifugal Pumps with Streamlined Flow.

Name _____ Position _____

Company _____

Street _____

City _____ State _____



Installed in 1926, this unit, still in service, attests to the long-time performance of R-C Meters.

NO PENSION FOR THIS OLD-TIMER even after 23 years of service

Accurate and dependable as always, this 23-year-old Roots-Connersville Meter still performs faithfully. No retirement for this veteran! Because new demands called for higher capacity, it has been transferred to another job in the same plant. Its old duties have been taken on by a new R-C unit, purchased because of fine performance of this old-timer.

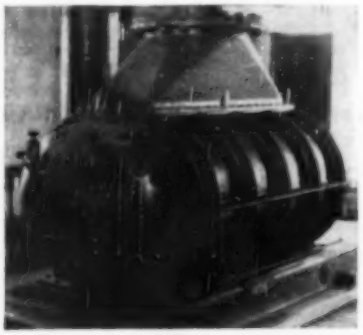
That's a common history of R-C Meters. They're built to measure accurately, and keep on doing it, year after year. Simple design, finely machined measuring surfaces and other important refinements account for their ability to measure gas accurately and unfailingly, almost indefinitely.

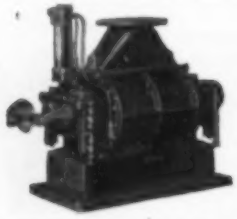
With 31 standard sizes and capacities from 4,000 to 1,000,000 cfh, R-C Meters meet the needs of most applications. Write for Bulletin 40-B-14 or tell us your specific requirements.

ROOTS-CONNERSVILLE BLOWER CORPORATION
506 Illinois Avenue, Connersville, Indiana

(Right) This R-C Meter, with capacity of 317,000 cfh, replaced the "old-timer" above, now transferred to other duties.

(Below) Typical small capacity R-C Meter for low and medium pressures.





ROOTS-CONNERSVILLE
BLOWER BUILDERS SINCE 1854
ONE OF THE DRESSER INDUSTRIES

primer and a protective enamel top coat in various decorative colors and in aluminum. Tests show that it is only necessary to wire brush loose rusty scale before painting.

The metal primer is scientifically formulated from a specially treated fish oil with high quality pigment that penetrates and provides a waterproof, air tight, elastic film that stops and prevents further rust.

The system of painting metal is especially recommended for industrial plants and other large buildings where the maintenance of metal is a serious problem.

NO ADHESIVE:

Display Sticker

(202A) A new display sticker that adheres to glass, and enameled, glossy, painted, or metal surfaces, with no adhesive required to make it cling, has been introduced recently by the Decal Plas-Stik Co.

The new product is a vinyl film cast from Geon Paste resin, a product of B. F. Goodrich Chemical Co., on which an advertisers name, slogan, or trademark is printed in multi-colors by the silk screen process. It sticks to glass or other surfaces readily and unlike conventional stickers can be removed easily leaving no mark or stain.

Barrel Polishing

(202B) A barrel polishing medium has been announced by Kube-Kut Inc. The medium is composed of hardwood (maple) in cube form to which has been added macerated corn cobs. Both materials are thoroughly screened and aspirated to remove dust, and the mixture combines the high absorption of the sawdust with the more tough'er polishing action of the pulverized corn cobs. The mixture permits drying and polishing of metals, plastics, rubber, wood, glass and other materials, irrespective of size, just so long as it can be handled by tumbling barrels in a minimum of time and at a low cost.

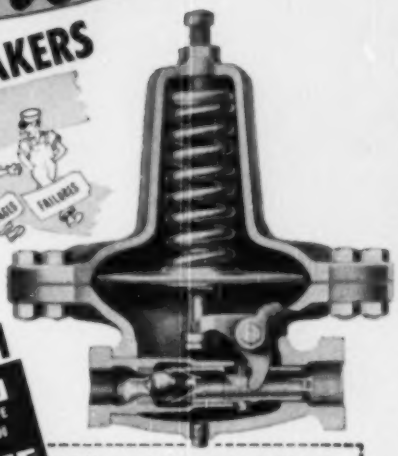
Sans Solvents

(202C) Hercules Powder Co. has taken the wraps off a new lacquer finishing technique, the "hot lacquer process." Heat is used instead of volatile ingredients to make the lacquer thin enough to spray. Features are cost savings, but more important, it offers the finishing industry a means of bypassing the serious and ever-growing shortage of volatile ingredients.

—*End*

IT'S GOODBYE Forever TO THESE TROUBLEMAKERS





IN PLANTS EQUIPPED WITH CASH STANDARD Streamlined TYPE 1000 PRESSURE REDUCING VALVES

The Reasons Why IT HAPPENS ARE TOLD BY USERS AS FOLLOWS . . .

Check what the users say against the Benefit Points Below

• A Rubber Goods Manufacturer says—

"We have used these Type '1000' valves for several years with fine results on air or water service at pressures from 10 lb. to 300 lb. depending on requirements. These valves as claimed have been found to have **LARGE CAPACITIES.** On **FLUCTUATING LOADS** or **STEADY LOADS** they are **MOST DEPENDABLE, RAPID IN ACTION** with a **QUICK DEMAND** and **TIGHT CLOSING** when the load drops off. They require but a **MINIMUM OF SERVICE OR MAINTENANCE."**

• A Chemical manufacturer says—

"The CASH STANDARD Type '1000' valves which we have in service have fulfilled the conditions checked . . . **(ACCURATE PRESSURE CONTROL UNDER TOUGHEST WORKING CONDITIONS), (TROUBLE FREE SERVICE), (TIGHT CLOSURE)** better than any other steam pressure reducing valves that we have used."

• A Metal Products company says—

"We have had a number of your CASH STANDARD Type '1000' valves in operation in our plant for a number of years. These valves have proved to be satisfactory in every respect. We particularly like this type of valve because it is **SIMPLE TO INSTALL, REQUIRES A MINIMUM OF MAINTENANCE,** and gives **CONTINUOUS** and **UNIFORM PRESSURE CONTROL.**

• A Plant Engineer says—

"We find that the CASH STANDARD Type '1000' streamlined valves are best suited for our various applications of compression molding because of their **VERY WIDE RANGE OF ACCURATE PRESSURE CONTROL.** The simplicity of construction of these valves has kept the **MAINTENANCE COSTS VERY LOW** which of course means a **SAVING IN COST OF OPERATION,** and **SPEEDIER PRODUCTION.**

1. **Maximum capacity when needed most.**
2. **Accurate pressure control under toughest working conditions.**
3. **Trouble-free service.**
4. **Smooth operation.**
5. **Tight closure.**
6. **Speedier production results.**
7. **Elimination of failures.**
8. **Cost-saving operation.**
9. **No spoilage.**
10. **Practically zero in maintenance.**

WRITE FOR BULLETIN 962

CASH STANDARD CONTROLS . . . VALVES

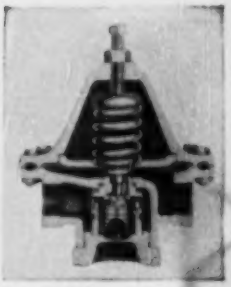
A. W. CASH COMPANY
DECATUR, ILLINOIS

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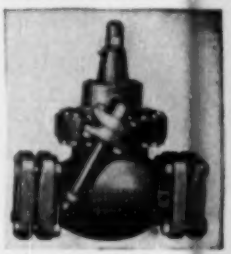
BULLETINS AVAILABLE ON OTHER CASH STANDARD VALVES

Send for them

•



Bulletin 950—features the CASH STANDARD Type D Single Seat Pressure Reducing and Regulating Valves for use with most fluids. Shows simple inner working parts that save in maintenance. Diagram explains how valve works. Blueprint shows simplicity of installation.



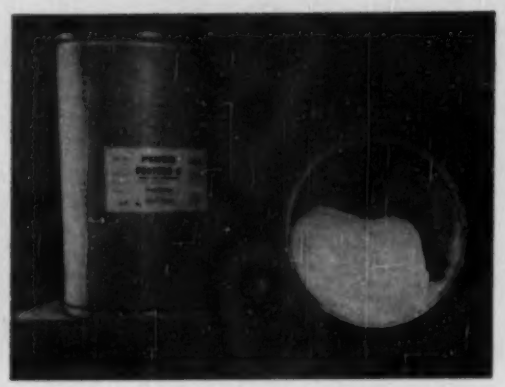
Bulletin 956—features the CASH STANDARD Type 4030 Back Pressure Valve — designed to automatically maintain a constant pressure in the evaporator corresponding to a predetermined temperature desired. Shows an Ammonia and Freon Gas Capacity Chart based on ABSOLUTE pressures.



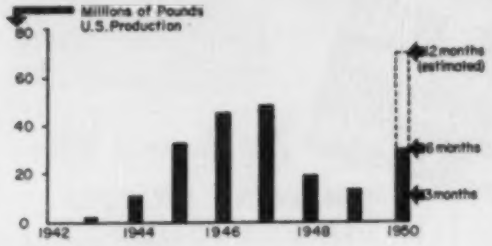
Bulletin 966—features the CASH STANDARD Self-Contained, Pilot Operated Type 10 Pressure Reducing and Regulating Valve for use with water or air; with any gas or oil that is non-corrosive; and with refrigerating fluids such as Ammonia and Freon. Many interesting particulars explained such as: how valve works, tight seating, large capacity, no waste, no water hammer or chatter.



PLANT at Natrona, Pa., where Pennsylvania Salt Manufacturing Co. makes DDT. Tank trucks or cars bring all raw materials.



PRODUCT of the operations at this plant; ground technical DDT which goes to market under the trade mark, Pentech H.



DDT

DICHLORODIPHENYLTRICHLOROETHANE

Meteoric—that's been the story of DDT, the bug killer. Tremendously successful during the war; in disfavor afterwards. It is coming back as some of its properties become better understood.

There are several commercial processes for the production of DDT. They vary in details but the usual method is the condensation of chloral and chlorobenzene.

Pennsylvania Salt Manufacturing Co. makes its own chloral. So the operations break down into two halves: making chloral; making DDT.

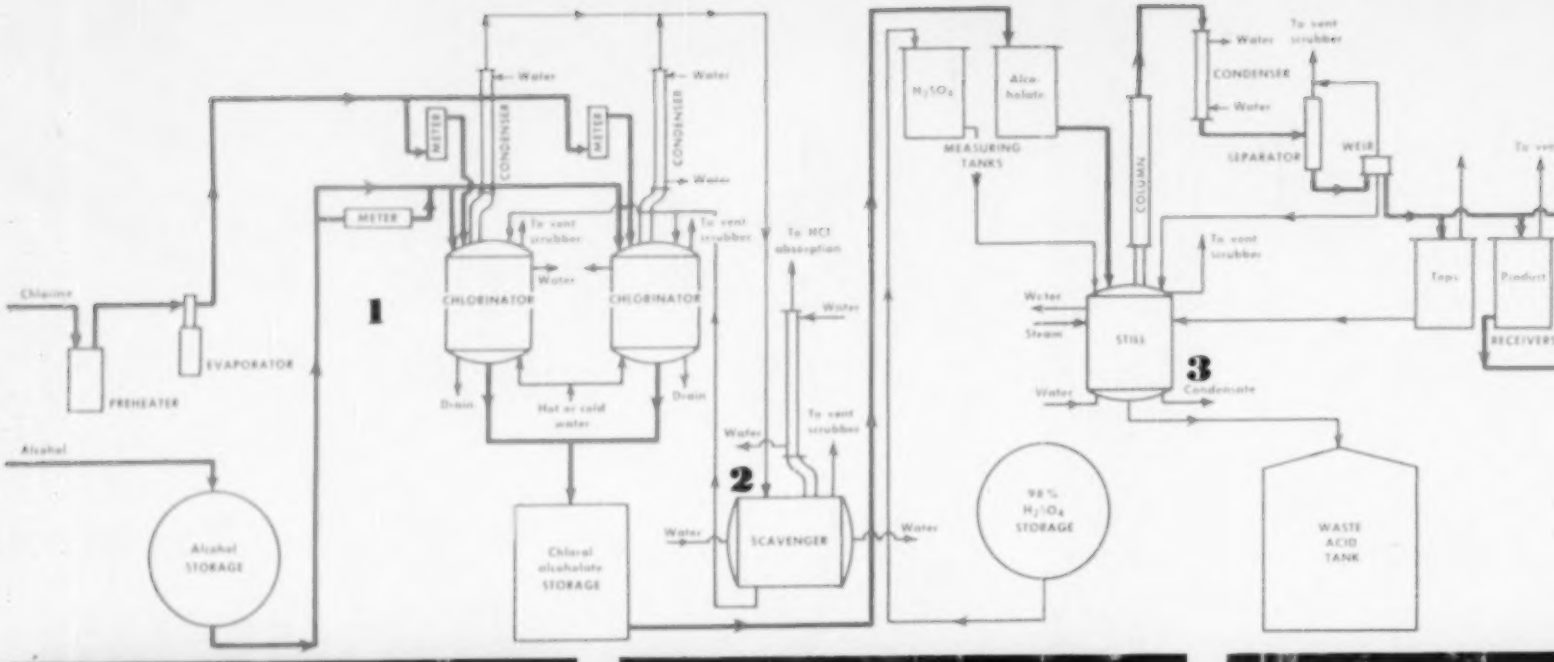
These are batch processes. But by having duplicate reactors the over-all effect is continuous operation. The Pennsalt plant at Natrona, Pa., has two units and can operate each continuously and independently. Raw material storage, however, is common to both units.

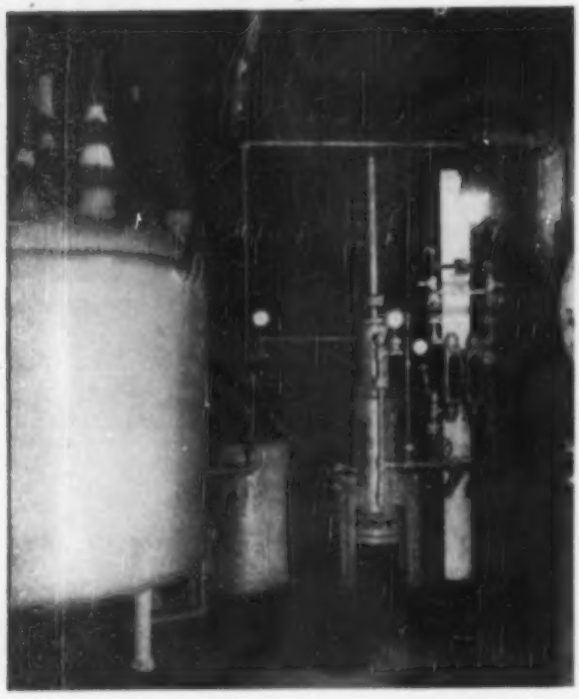
Raw materials for chloral are alcohol, chlorine and sulphuric acid. At Natrona, Pennsalt receives its chlorine in tank cars. It goes through a preheater, evaporator and rotameter on its way to one of the 750-gal. chlorinators. Alcohol also comes to the plant in tank cars or tank trucks. It is metered to the chlorinator.

Chlorination takes 60-70 hr. Temperature is controlled as required to a time-temperature schedule by running hot or cold water through the jacket. Overhead goes to a 1,000-gal. scavenger that recovers alcohol, vents the small amount of ethyl chloride produced, and separates out the HCl for absorption. The chloral alcoholate product goes to a 2,000-gal. storage tank. It is pumped, as needed, through a 420-gal. measuring tank to a still where distillation with 98 percent sulphuric acid causes decomposition into chloral and alcohol. This chloral is ready to become DDT.

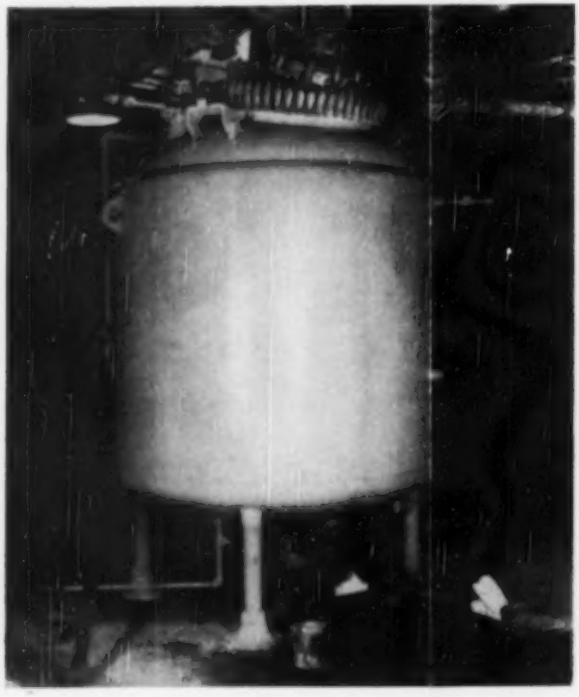
It is charged, with chlorobenzene and oleum, into a 1,000-gal. acidproof reactor. Rate of charging, as well as brine and steam coils, controls the reaction at 60 to 85 deg. F. Reaction takes 5 to 6 hr. and when it is finished the spent acid separates out. This acid is drawn into a 500-gal. recovery tank. The DDT is water washed several times in the reactor, soda ash being added to the last wash to neutralize the remaining acid. The mixture of DDT and chlorobenzene is then dropped to a steam heated, 500-gal. dryer. The chlorobenzene is recovered and the DDT is released into casting pans where it solidifies. It is broken, chilled, crushed, ground, milled, and shipped.

Raw materials and energy requirements per thousand pounds of DDT are approximately: 360 lb. alcohol; 1,200 lb. chlorine; 900 lb. sulphuric acid (98 percent); 900 lb. chlorobenzene; 4,500 lb. sulphuric acid (100 percent); 20 lb. sodium carbonate; 3,500 lb. steam; 96 kwh.





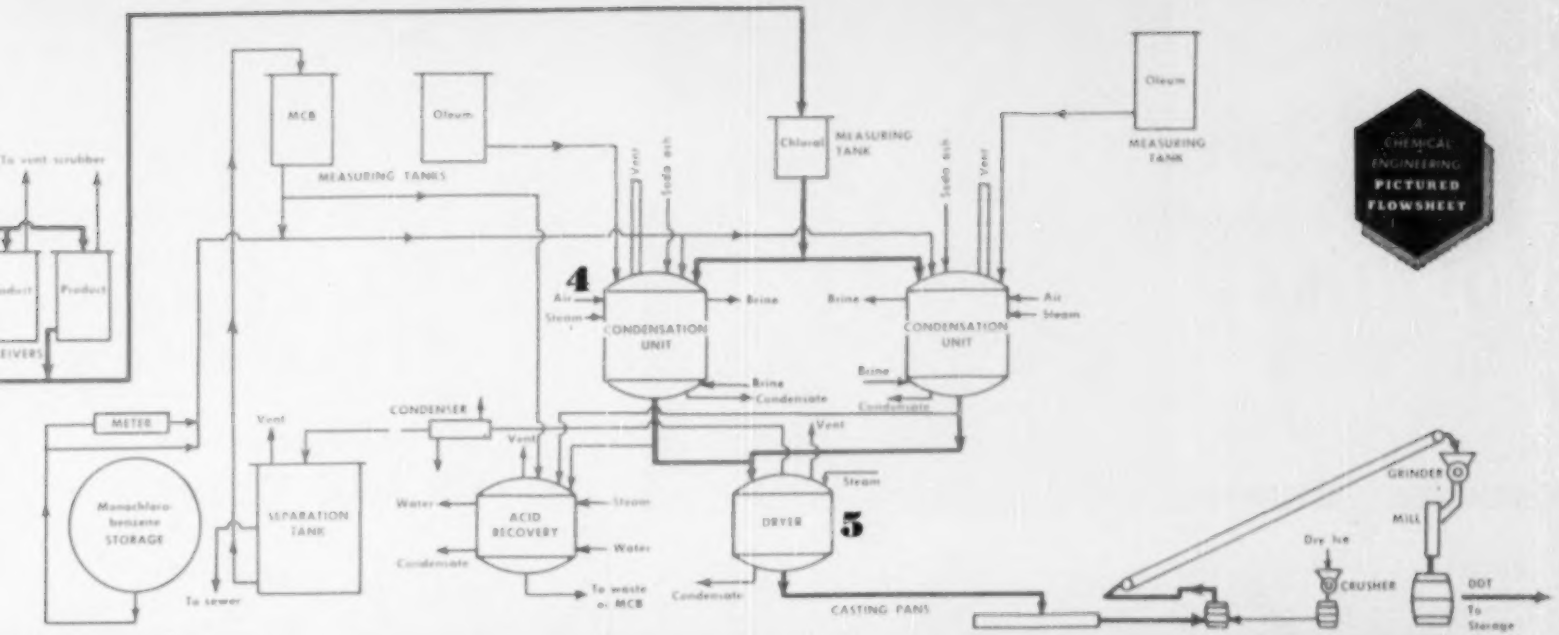
1 CHLORINATOR, chlorine evaporator (designed by Pennsalt engineers) and flow rate control apparatus. The chloral alcoholate is made here.



2 SCAVENGER is a 1,000-gal. vessel that receives overhead from the chlorinators, separates out HCl, and recovers alcohol and alcoholate.

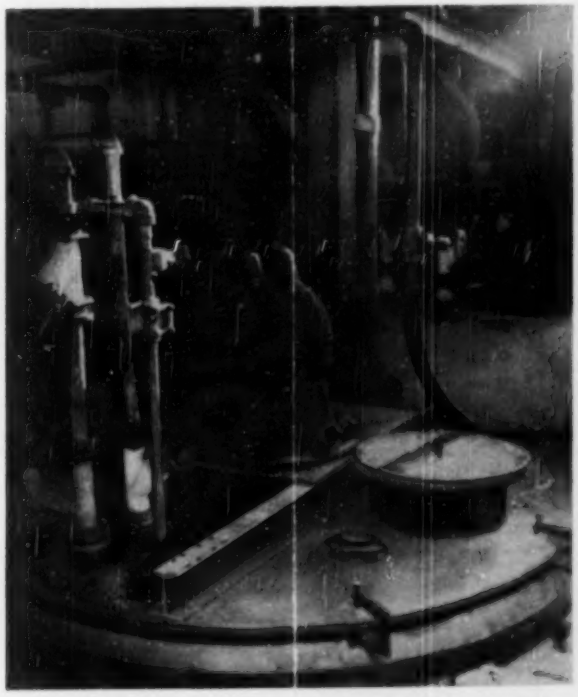


3 STILL (one of two) where 98 percen alcoholate into chloral. Each 1,000-g

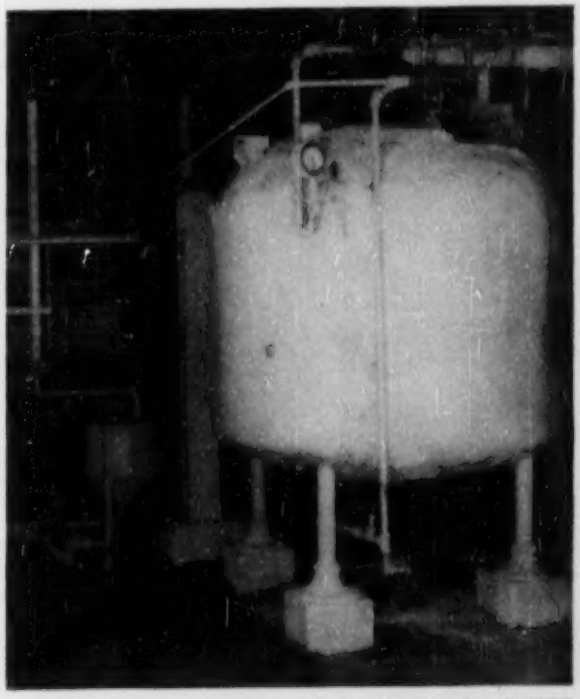




percent sulphuric acid converts chloral
,000-gal. still serves two chlorinators.



4 CONDENSATION UNIT (top) showing agitator drive, connections, and solid porcelain valves. Here is where the chloral becomes DDT.



5 DRYER, steam heated, recovers chlorobenzene. From here the DDT flows to casting pans. Ground and milled, it is ready for shipment.

3 BIG REASONS For Choosing TOLHURST SUSPENDED CENTRIFUGALS



1 SPEEDIER

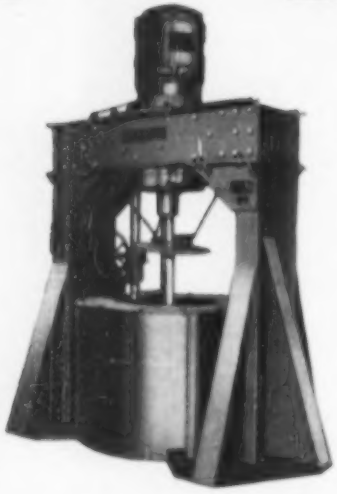
Tolhurst two-speed drive and basket unloading plow permit shorter operating cycles and increased production.

2 SMOOTHER

Aperiodic mounting, exclusive with Tolhurst Suspendeds, permits smooth operation even with out-of-balance loads.

3 SAFER

Tolhurst Suspendeds are carefully designed, precision-built and rigidly tested. You can rely on Tolhurst's 98 years experience.



Tolhurst Suspended Centrifugals are equally efficient whether slow or fast starts or repeated short cycles at full speed are required. Baskets can be perforate or imperforate, constructed of steel, steel rubber covered, stainless steel, monel and other alloys. Basket diameters: 26", 32", 40" and 48".

WRITE FOR ILLUSTRATED CATALOG TC-3-48.

DO THESE 6 JOBS FASTER MORE ECONOMICALLY

FILTERING	CLARIFYING
DRAINING	THICKENING
DEHYDRATING	SEPARATING

TOLHURST CENTRIFUGALS

Division of AMERICAN MACHINE AND METALS, INC.
EAST MOLINE, ILLINOIS
In Canada: American Machine and Metals (Canada) Ltd., 1144 Weston Road, Toronto 9, Ontario

Longer service life lower final cost

with dependable CRANE VALVES

CASE HISTORY FROM CRANE FILES

PROBLEM: To find a more efficient and economical re
cocks having an average life of only 2 to 8 weeks in
liquid clay to filter presses.

WORKING CONDITIONS: Working pressure 140 psi,
clay flow creating highly erosive effect; also corros
tendency to clogging. Operating cycles 5 to 6 per da
quick opening and closing required.

SOLUTION: Crane No. 1610 Diaphragm Valves,
packless design, with separate disc and diaphragm

RESULT: After 11 months' uninterrupted service, C
showed no significant wear or damage resulting fr
operating conditions. User assured of greatly redu
nance and replacement costs over plug cocks. No
phragm valves approved for standardization o
press piping.

*Another example of the greater value in Crane Quality, o
final cost of Crane Valves for every service. That's wh*
More CRANE VALVES are used than any other

CRA

CRANE CO., *General Offices:* 836 S. M
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VALVES • FITTINGS • PIPE

life at



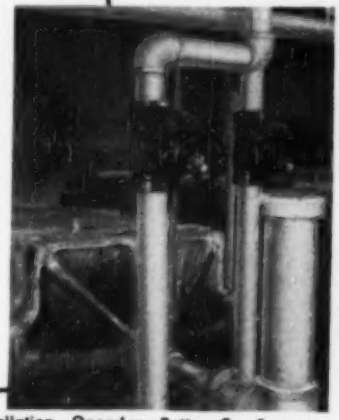
al replacement for plug
s in pipe lines handling

No. 1610 Diaphragm Valve. Ask for literature on full line through your Crane Branch or Crane Wholesaler.

0 psi, with liquid
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reduced mainte-
No. 1610 Dia-
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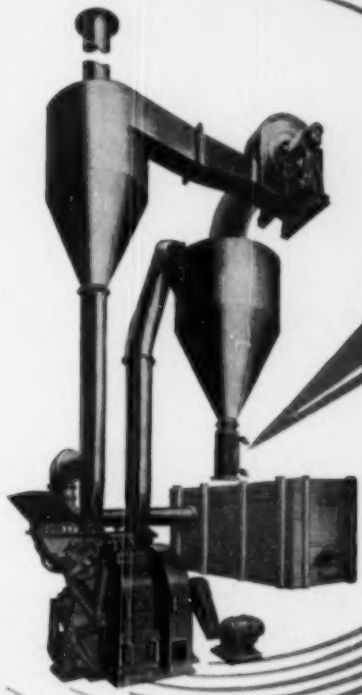


The installation—Onondaga Pottery Co., Syracuse

ANE

S. Michigan Ave., Chicago 5, Ill.
erving All Industrial Areas

E • PLUMBING • HEATING



Flash-Dry YOUR PRODUCTS

with the Raymond IMP MILL

Product Quality
•
Temperature Control
•
Automatic Handling
•
Adjustable Fineness
•
Production Economy

This modern Raymond equipment offers you the greatest possible production savings because it combines *two* operations in *one*.

These two operations are handled at the same time by the Imp Mill . . . automatically and dustlessly . . . without the use of separate dryers or conveyors.

There is wide application for Raymond Flash-Drying in many chemical and food manufacturing processes, where products must be reduced to powdered form and dried to a definite moisture content.

The Imp Mill installation is flexible enough to fit practically any plant layout . . . and is available in a number of different types and sizes to suit your requirements.

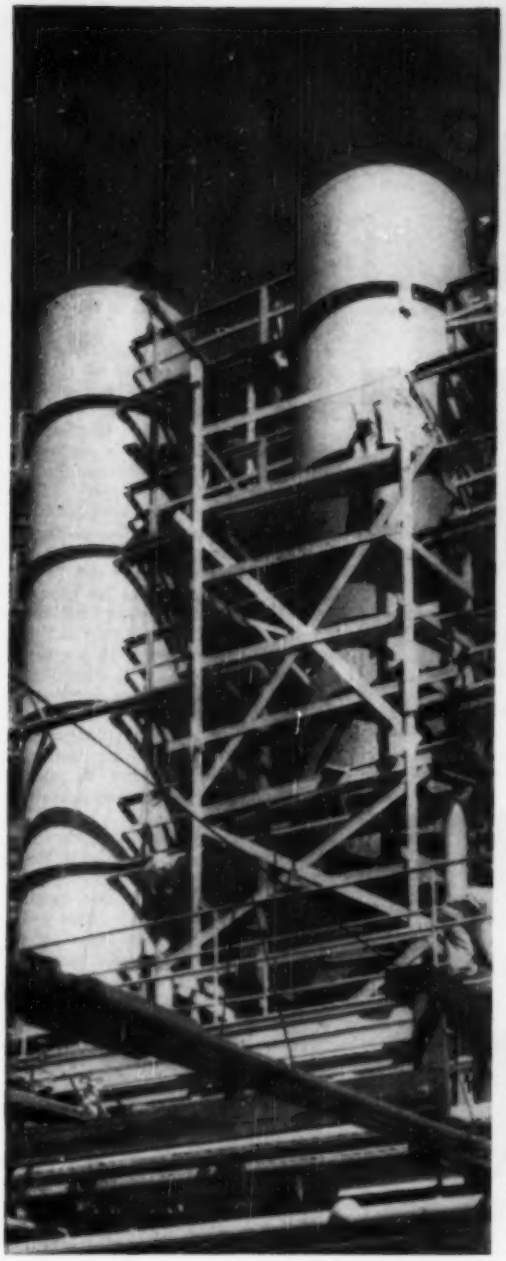
For further details, ask for Catalog #54A

COMBUSTION ENGINEERING-SUPERHEATER, INC.

Raymond
PULVERIZER DIVISION

1311 NORTH BRANCH ST.
CHICAGO 22, ILLINOIS

Sales Offices in Principal Cities





U. S. Rubber's top brass watches first 75-lb. bale of synthetic rubber roll off the line at reopened Port Neches, Tex., plant.*

Synthetic Snaps Back

First of the nation's all-purpose synthetic rubber plants to be reactivated under the government's expanded rubber program started production October 12, twenty days ahead of schedule. It's the $11 million government-owned GR-S copolymer plant at Port Neches, Tex., operated by United States Rubber Co.

Originally designed to produce 60,000 long tons a year, the huge plant has been modernized by U. S. Rubber engineers to produce more than 72,000 long tons a year. Output will increase gradually until peak capacity of 6,000 long tons per month is reached by December 1. This will mean a boost of 17.5 percent above current industry production. John P. Coe, vice president and general manager of the company's Naugatuck Chemical Division, says the rubber will be used to meet skyrocketing civilian and military demands for tires and other rubber products.

"Reactivation and modernization were accomplished in less than three months at a cost of $1,030,000," according to Coe. "Of this total $530,000 was utilized for modernization and $500,000 for actual reactivation. Modernization was accomplished at much less cost than would have been required if improvements were made after the plant was in operation," he says.

Every valve, tank and reactor, as well as a maze of piping, were torn down, cleaned, inspected and finally assembled. New metering equipment was installed to improve the handling of raw materials. New pumps were installed to increase the plant's capacity for handling raw materials and to improve efficiency in handling latex. Piping systems throughout the plant were simplified. Laboratory facilities were expanded and modernized to maintain better quality control, and new equipment was added to improve recovery of unreacted raw materials.

Five days after actual production started, the plant was

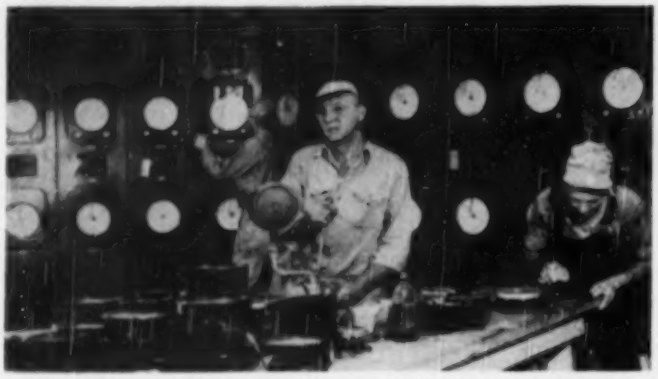
* Left to right, John P. Coe, vice president and general manager of the Naugatuck Chemical Division; Harry E. Humphreys, Jr., president of U. S. Rubber; Thomas A. McCoy, Port Neches plant manager; and John C. H. Wendes, production manager for the Naugatuck Chemical Division.

(Continued)

Reactivation



CLEANING EQUIPMENT was speeded up by use of this portable high-pressure steaming apparatus. Here the portable steamer is used to clean styrene condenser.



OVERHAULING CONTROLS was a vital step in getting the plant ready for operation. Workmen are checking pressure gages, temperature and pressure recorders.



INSTALLING DRYER FLIGHTS of stainless steel to replace original black iron ones was part of modernization at Port Neches, Tex., GR-S copolymer plant.

formally reopened on October 17. Top U. S. Rubber officials arrived by plane from New York to attend the ceremonies and to watch the first 75-lb. bale of synthetic rubber roll off the line. President Harry E. Humphreys, Jr., was accompanied on the trip by Christy H. Madsen, Naugatuck assistant production manager, and J. Scott Brown, chief engineer of the division. Coe, together with John C. H. Wendes, Naugatuck production manager, and Russell M. Tobias, purchasing agent for the chemical division, had arrived earlier. Business and civic leaders from southeast Texas communities gathered for the formal reopening of the Port Neches plant.

Gerald B. Hadlock, executive director of RFC's Office of Rubber Reserve, flew from Washington, D. C., for a one-day inspection of the plant with company officials.

"The rubber industry," according to Humphreys, "is consuming rubber —both natural and synthetic—at an all-time record high of 1,200,000 long tons a year. Use promises to go even higher during 1951, with synthetic rubber representing approximately 60 percent of this total."

Predicting that the swing to synthetic will not produce the technical headaches encountered during World War II, Humphreys points out, "Synthetic can be tailor-made for specific applications. There is almost no limit on the varieties of synthetic rubber which can be produced. In the case of GR-S synthetic more than 500 varieties have already been developed. Its price structure is more stable than natural because it is not traded on the open market but is a manufactured product. Its quality can be more closely controlled because it is chemically made."

Nevertheless, Humphreys warns that it is extremely important today to have an adequate supply of nature's product to mix with man-made rubber where it is needed. "To assure ourselves of this supply," he says, "is becoming more and more of a problem. Our government has a big competitor to deal with. Russia is buying rubber hand over fist through agents in Malaya. Value of rubber exports to Russia in July was almost twice as large as June. Russian imports have climbed from 9,500 tons in 1946 to more than 105,000 tons in 1949 and they are heading higher."

Vice President John P. Coe of U. S. Rubber's Naugatuck Chemical Division says that the nation's copolymer plants are expected to be geared for a

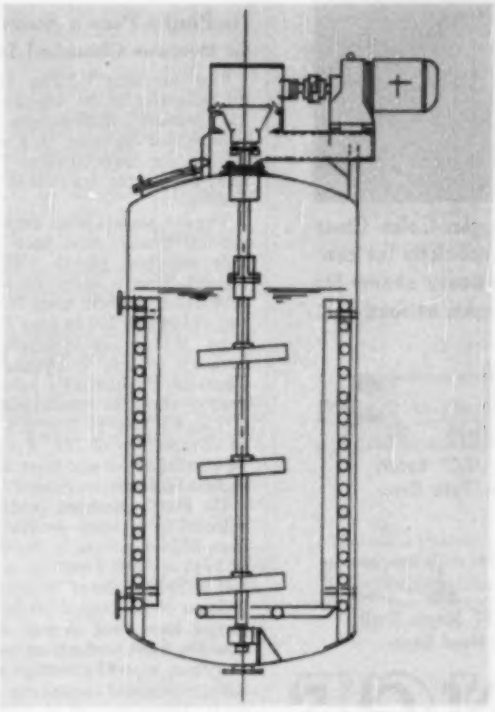
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The reason behind Turbo-Mixer's continuing leadership can be summed up in two words . . . *creative mixing.* For whether the unit mixes liquids with liquids, solids and/or gases—without exception, it is built for the job to be done. Custom-designed for day-in, day-out, 24-hour peak performance.

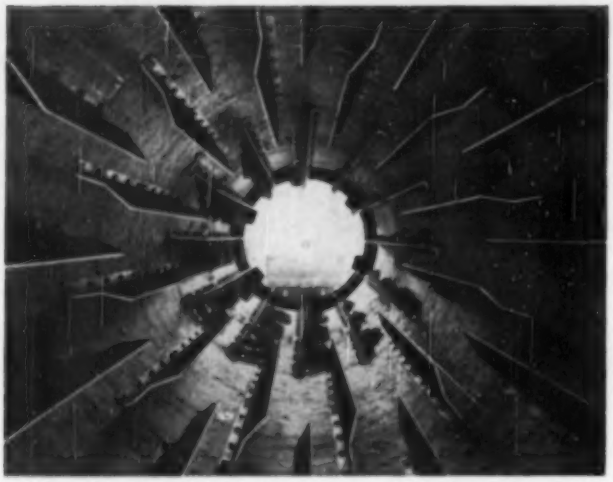
Evidence of this efficiency and dependability can be found in the fact . . . that Turbo-Mixer has produced over 80% of the fermenters in the anti-biotic field throughout the world!

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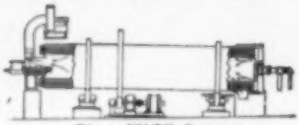
NEW DEVELOPMENT IN CONTINUOUS ROTARY DRYERS



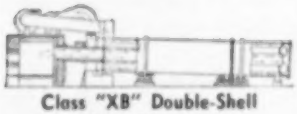
You are looking at the interior of a Ruggles-Coles Class "XH" Single Shell Rotary Dryer designed especially for continuous drying of sticky materials. Note heavy chains for "knock-out" of materials behind lifting flights at feed end.



Class "XA" Double-Shell Direct-Heat Dryer



Class "XC" Rotary Steam Tube Dryer



Class "XB" Double-Shell Indirect Heat Dryer



Class "XF" Single Shell Direct-Heat Dryer

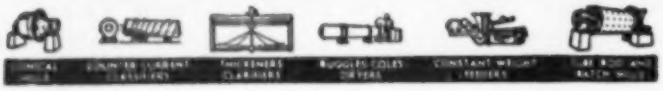
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turnout of approximately 760,000 long tons of synthetic by early next year.

Annual tonnage, through reactivation of plants now or later, will be upped from about 200,000 long tons, production about a year ago.

The center of rubber production may well shift from the plantations of the Far East to Texas. Five of the government's plants operating in Texas will be capable of producing from 250,000 to 300,000 long tons of all-purpose synthetic a year or about 40 percent of the nation's supply, Coe says. Two of the plants are located in Port Neches, under operation by B. F. Goodrich Chemical Co. and U. S. Rubber, and the remaining three are at Borger, Houston and Baytown.

The nation's total program for a buildup of a synthetic rubber industry will amount to around 900,000 tons a year, Coe estimates.

Du Pont's Pace a Scorcher In Postwar Chemical Race

Five years after V-J Day, Du Pont, the bellwether of the American chemical industry, demonstrates by its stamina that the entire U. S. chemical industry was never stronger. It stands ready to meet the demands of national security.

The five postwar years, despite international tension, have been years of wide industrial growth. While the Federal Reserve index of industrial production climbed from 161 at the end of 1945 to 200 in June 1950, the index of chemical production rose from 231 to 259. In December 1945 *Chemical Engineering's* index of industrial chemical consumption stood at 182; by May 1950 it had reached an all-time high of 261. For the first six months of this year it averaged 244, highest half-year on record.

Du Pont's increased production is reflected in a steady growth of sales, from $326.4 million in the first half of 1945 to $580.9 million in the first half of 1950, a rise of 78 percent.

Some of the biggest production increases have come in such relatively new Du Pont products as nylon and neoprene, important wartime materials with widespread peacetime applications. Since the end of World War II, Du Pont has started production of many new products. Among them: Orlon acrylic fiber; Fiber V; titanium metal; a metallic chrome lacquer; and a host of agricultural chemicals and insecticides.

Expansion has been made possible only by Du Pont's substantially larger investment. Average operating investment rose from $832.8 million for the year 1945 to $1,375.5 million for

the first six months of 1950. Of the more than half billion dollar increase, $100 million came from sale of a million shares of preferred stock in 1947. The remainder resulted from internal growth: principally reserves for depreciation and obsolescence and funds from undistributed earnings reinvested in the business.

Return on investment, low in the war years, rose in the postwar years to a level approximating that of 1939, when it was equal to 9.8 percent of average operating investment. Net operating income equalled 9.4 percent of average operating investment in 1946; 7.7 percent in 1947; 9.3 percent in 1948; and 10.5 percent in 1949.

Between mid-1945 and mid-1950, Du Pont spent about $474 million for the building and expansion of plants, laboratories and equipment. Most significant for Du Pont's future is the $30 million expansion of the Experimental Station in Wilmington, now nearing completion.

Number of employees on the rolls of Du Pont and its wholly owned subsidiaries reached a record peacetime high of 79,500 in June 1950. This compares, incidentally, with an estimated 1950 population of 109,907 for Wilmington, Du Pont's headquarters city. Stockholders on June 30, 1950, numbered 118,732, also a new high, and an increase of 35 percent since June 30, 1945.

(Continued)

CONVENTION CALENDAR

American Society of Mechanical Engineers, Hotel Statler, New York, November 26-December 1.

American Pharmaceutical Manufacturers Association, midyear meeting, Waldorf-Astoria Hotel, New York, November 27-29.

19th National Exposition of Power & Mechanical Engineering, Grand Central Palace, New York, November 27-December 2.

Chemical Specialties Manufacturers Association, New Yorker Hotel, New York, December 3-5.

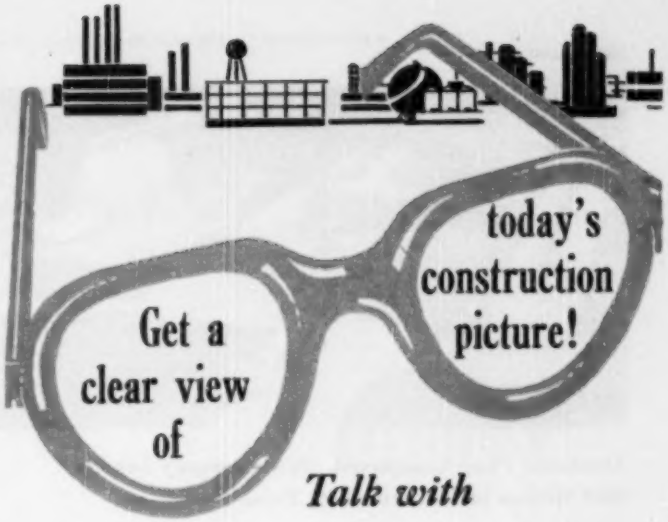
American Institute of Chemical Engineers, annual meeting, Neal House, Columbus, Ohio, December 3-6.

Society of Cosmetic Chemists, fall meeting, Biltmore Hotel, New York, December 5.

Synthetic Organic Chemical Manufacturers Association, annual meeting, Commodore Hotel, New York, December 6.

Plant Maintenance Show, Auditorium, Cleveland, January 15-18.

Society of Plastics Engineers, national technical conference, Statler Hotel, New York, January 18-20.

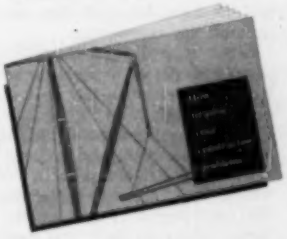


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Ammonia Plant Completed, Dow Promptly Invests $30 Million in Mushrooming Texas Operations

Latest addition to the burgeoning Texas operations of Dow Chemical Co. is the $5 million Freeport ammonia plant just completed. It will turn out anhydrous ammonia, both the refrigeration and technical grades, for agricultural and industrial uses.

It was only a little over a decade ago that much of the area around Freeport and Velasco, Tex., was grazing land. But the area was rich in untapped resources. It had abundant gas and oil and a virtually unlimited source of sea water from the Gulf, besides a deep water harbor at Freeport, rail facilities and the Intracoastal Waterway nearby.

Eyeing these advantages, the Dow managers decided to locate their first Texas plant in the area. In this plant Dow made the first magnesium metal ever produced from sea water brine. Production started in January 1941 just in time to meet the war-born demand for magnesium.

Since then Dow has steadily expanded its Texas operations so that today it is producing not only magnesium but a raft of industrial chemicals, agricultural chemicals and plastics in plants at Freeport and Velasco.

In 1946 the styrene plant at Velasco, which Dow built and operated for the government as part of the synthetic rubber program, was purchased from the War Assets Administration. The company at the same time acquired from WAA part of the government-owned, Dow-operated magnesium plant at Velasco, excluding, however, the magnesium metal producing facilities. Also now owned by Dow are two additions to the company's original magnesium plant at Freeport, one of which was built for and financed by the British government and the other by the United States.

AMMONIA IS JUST THE BEGINNING

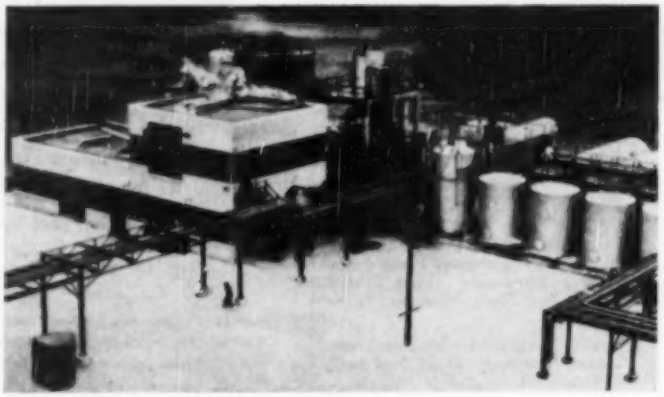
Early in 1950 construction was started on the $5 million ammonia plant at Freeport, which is just now getting into production. Then, last June, President Leland I. Doan announced an additional $30 million expansion program for the Texas Division. The decision to go ahead with this whopping expansion came after a meeting of Dow's board of directors at the Texas Division headquarters in Freeport—the first session of the board in Texas since Doan became president in April 1949.

The new construction program, now under way, includes facilities for the production of ethylene, chlorine, styrene, glycols, vinyl chloride and vinylidene chloride.

Greatly enlarged demand for plastics over the past year has made necessary increased production of styrene, from which Styron, a Dow plastic, is manufactured. And now, as a result of the national emergency, reopening of the synthetic rubber plants has sent the demand for styrene soaring. Vinyl chloride and vinylidene chloride are used in making saran, another Dow plastic.

Demand for glycols and ethylene oxide has also increased substantially in the past year, hence the need for additional production facilities.

Thus Dow once again demonstrates its faith in the potentialities of its Texas Division. President Doan puts it this way: "This is a great industrial section and we hope to continue right on expanding."



Armour Uses Texaco's Novel Process to Separate Oil Components by Fractional Crystallization

A new process for separating components of vegetable, marine and animal oils has been worked out by Texaco Development Corp. By a special technique, the materials are chilled in solvent to crystallize out in solid form the desired component. The new process finds its first commercial application in a multi-million dollar chemical plant now being completed near Chicago, Ill., by Armour & Co.

The plant, which is currently being placed in operation, will be used for the production of chemicals for deodorants, germicides, paints, cosmetics, salad oils and textiles. Armour & Co. installed and will operate the crystallizer process under a joint licensing agreement with the Texaco Development Corp.

With the new process, fat compo-

(Continued)



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nents can be produced in practically pure form. The process is known as the fatty oil fractional crystallization process. The high-purity fractions separated are the commercially important saturated and unsaturated fatty acids such as stearic, oleic and linoleic, as well as the glycerides.

Separation of these materials is of growing importance to a wide variety of industries. Such high-purity separation of saturated from unsaturated fatty components has long been sought. This crystallization process is a valuable partner of the fractional distillation process that has long given high-purity separation of the fatty components of different chain lengths. Advent of the fatty oil fractional crystallization process makes available a powerful new tool, to be used either separately or in conjunction with fractional distillation, for the commercial production of a full range of high-purity fatty oil components.

Engineer to Study Europe's Mixing and Milling Machines

D. F. Collins, a research and development engineer for Adamson-United Co., equipment manufacturer for the rubber, plastic, metal and plywood industries, left Akron, Ohio, in mid-October for an extensive trip to industrial machinery plants in England, Italy, France, Holland and Belgium. Adamson-United is a subsidiary of United Engineering & Foundry Co. of Pittsburgh.

Collins plans to study latest European developments in mixing and milling equipment for the rubber and plastics industries, particularly those reported to be distinct departures from methods presently employed in this country.

Considerable time will be spent by Collins in England, where, according to F. L. Dawes, president and general manager of Adamson-United, great strides have been made on the development of continuous internal mixing and milling machinery.

"It is no secret among rubber and plastics equipment manufacturers," Dawes says, "that Europeans have been more active than we have in the development of continuous production machinery.

"While we in the states have been setting the pace in production of finished rubber products through plant expansion, we have done very little in improving our basic rubber processing machinery."

Dawes indicates that Collins' assignment overseas is in furtherance of a working arrangement already in ef-



D. F. Collins

fect between Adamson-United and several European manufacturers. As a result of one such arrangement, Adamson-United has obtained manufacturing rights for the "rotocure," a continuous production machine that is coming into use in this country for the manufacture of belting, flooring and other flat goods.

Bates Named Director of NPA's Chemical Division

A Pennsylvania chemical executive has been chosen by the National Production Authority to head the division that will administer controls on the chemical industry. Joseph S. Bates of Media, Pa., president of Bates Chemical Co., began service as director of the chemical division of NPA on October 16.

Bates, 60, served with the War Production Board and with the Army during World War II. He is a native of Abington, Conn.

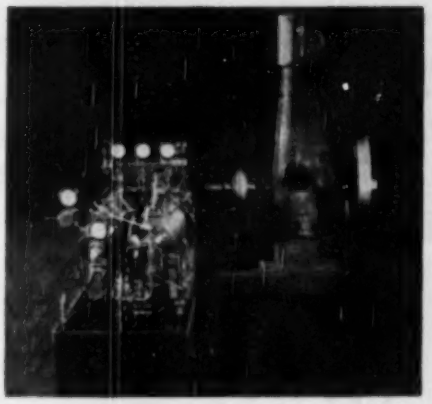
Assisting the new director will be Charles C. Concannon, Lawrence Kilgore and the full staff of the chemical division of the Department of Commerce.

Military and Industry Needs For Chemicals Get Airing

The chemical industry has grown strong in the past because it has been built on a continuing flow of new products. Modern chemical firms aim at getting at least 50 percent of their sales from products which are less than ten years old.

To make sure that this growth can be carried forward to the mutual benefit of the industry and the nation as a whole in times of emergency, last month the members of the Commercial Chemical Development Association and the Chemical Market Research Association got together with military research men and representa-

(Continued)



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tives of some of the nation's leading firms. They let their hair down to discuss their problems in the current rearmament effort.

Leading off the two-day session at Washington's swank Mayflower Hotel, representatives of the Army, Navy and Air Force pointed out that our defense is based on our technological ability to supply our fighting forces with superior equipment that will perform properly in all parts of the world. While the Army generally needs the same type of chemicals and chemically derived products as in World War II, it is stressing better quality and greater usefulness.

Speaking for the Department of the Army, Col. L. S. Griffing said, "We paid dearly in packaging in World War II, more will have to be done in fungus-proofing and weather-proofing." The many problems that beset the Army call for pioneer thinking, he said.

Col. C. H. M. Roberts, speaking for the Chief of Ordnance, explained that Army Ordnance wants new adhesives that can withstand wide temperature ranges, optical cements, fungus-proofing and rust-proofing, and stripable compounds for use in things like spray cocooning.

Army Quartermaster is looking for an insect repellant that will last longer than the two or three hours during which present preparations are effective. In explaining this need Dr. Warren Stubblebine, head of the chemicals and plastics section in the Quartermaster General's Research and Development Branch, said that in addition to a longer repelling life it must be of the rub-on variety.

He pointed out that another urgent need is a truly all-purpose soap. The soap should be made without cocoanut oil (preferably of some synthetic non-strategic compound) and be usable for everything from shaving to cleaning of equipment.

Flameproofing compounds were another problem that Dr. Stubblebine tossed into the hopper. Present compounds are fairly effective, but they add 50 percent to the weight of a tent. The ideal flameproofing agent should be lightweight, able to preserve the soft feel of fabrics, be laundryproof and weatherproof.

Many of the problems posed the chemical development men by the Army were repeated by the Navy and Air Force spokesmen. They added a few more for good measure.

Rear Admiral T. A. Solberg pointed out that better corrosion resisting coatings are needed. Improved non-flammable hydraulic fluids with better

(Continued)

ALCOA

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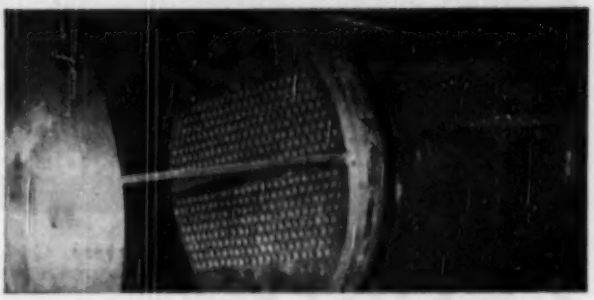
Roll-in and other fabrication go faster with Alcoa Tubes. Your present tools and techniques will do the job. Aluminum is easy to machine and to weld.

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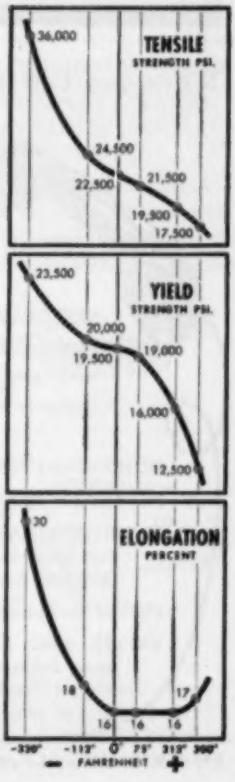
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These three graphs show the amazing increase in tensile properties of aluminum as temperatures drop below zero.

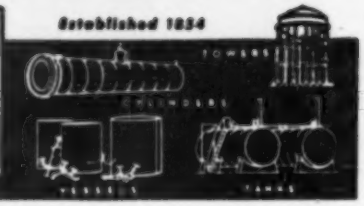


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viscosity characteristics than those now available are among the Navy's chemical problems. Lightweight batteries which do not use strategic metals would be a vast help in submarine development.

On the industry side of the picture, C. L. McCuen led off a symposium on industry needs and problems by explaining the wide needs for chemicals in the automobile industry. More than 250 chemical products go into the automobile industry. Each automobile takes about 5 lb. of plastics. Thus the industry consumes about 15,000 tons of plastics materials each year. The average car consumes 4,200 gal. of gasoline each year. In its lifetime it will consume about 20 tons. In order to build the cars that manufacturers hope to offer customers in the future there is need for higher octane fuels, better lubricating oils, better batteries, automatic transmission fluids, cleaning compounds, plastics, protective coatings, corrosion inhibitors, and improved solvents.

H. B. McClure, vice president of Carbide & Carbon Chemicals Division, described the improvements made in octane ratings for gasoline. He showed that for the same price today's gasoline delivers 50 percent more power than it did in 1925. He said that by 1955 the premium gasolines will have an octane rating of 95. Gum formation in gasoline is being cut down by copper deactivators such as disalicylal propylene diamine.

Today more than 35 million pounds of solvents are being used in manufacturing improved lubricating oils. Additives include anti-oxidants, detergents, viscosity improvers, rust inhibitors, antifoam agents, and oiliness agents. Mr. McClure pointed out that, "The chemical industry is challenged to develop an oil which will not change in viscosity from 60 to 300 deg. F., which will be stable under all engine operating conditions and which would have low friction wear characteristics."

K. A. Taylor explained some of the paper industry's problems that would be of interest to chemical firms. They included increased use of ammonia in ammonia base sulphite pulping, recovery of chemicals in pulping processes, cheap germicide and insecticide treatment of stored pulpwood, control of insect blights, better fire retarding and flameproofing materials.

Milton Harris spoke on the needs of the textile industry. Here again better detergents are needed. He pointed out that cooperation between textile firms and chemical producers is necessary to speed acceptance of new and better textile treating agents.

Muss resistants, dimension stabilizers, better mothproofing agents, better dyestuffs, new flameproofing chemicals, and new fibers will all rate special attention in the textile industry.

J. E. Eberhardt and Clyde Williams discussed the chemical needs and progress in chemical products in the steel industry. They showed that there was an even larger market for chemicals in the industry than exists today. It is possible that this industry may become an even bigger producer of chemicals.

Helium Plant at Amarillo Reopened by Government

The federal government has announced reopening of its helium plant at Amarillo, Tex. Secretary of the Interior Oscar Chapman said that the plant is needed to meet steadily increasing defense and industrial demands.

The plant has been closed on a stand-by basis since September 1946. Its annual output of 36 million cubic feet, together with the annual production of 60 million at another government plant at Exell, Tex., is expected to be ample to meet all current demands for helium.

Pilot Plant Will Test New Chlorine Process on Sewage

University of Texas School of Medicine will operate an experimental pilot sewage treatment plant, scheduled to be built shortly on the site of the present Pasadena, Tex., sewage treatment plant.

Dr. C. H. Connell, associate professor of sanitary chemistry at the university, said that he hopes to develop improvements over present methods of treating sewage, and added that laboratory tests so far prove the new chlorine process to be superior to present methods employed by municipalities.

Dow Hikes West Coast Output Of Chlorine and Caustic

Dow Chemical Co. will expand by one-third its West Coast production of chlorine and caustic soda. The move, just authorized by the firm's board of directors, is necessitated by the general expansion in West Coast industry. It will be accomplished by enlarging present facilities at the company's Pittsburg, Calif., plant.

R. L. Curtis, general manager of Dow's Great Western Division and a vice president of the company, says no new buildings will be required but

(Continued)

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existing chlorine-caustic cells will be enlarged and new boiler and substation equipment installed. He estimates the work will take 10 to 12 months. Its probable cost: $1.5 million.

Dow supplies chlorine for water and sewage treatment in California but uses the bulk of its own production in the manufacture of industrial solvents, bleaching materials and agricultural chemicals. Caustic soda, companion product of chlorine production, is used in large quantities by the petroleum and canning industries and in the manufacture of chemicals, soaps and synthetic detergents.

Coking Unit Completed At Arkansas Refinery

Dedication ceremonies at Pan-Am Southern Corp.'s new refinery at El Dorado, Ark., marked completion of a multi-million dollar coking unit at the company's refinery. This coking unit can process 9,300 bbl. of crude bottoms per day, producing gas, gasoline, gas oil, and coke.

Gas oil is processed in the catalytic cracker to make high-octane gasoline, while the coke can be used for domestic and industrial heating and for the production of carbon electrodes for aluminum reduction. At the present time men are at work at Pan-Am on a second catalytic cracker, scheduled for operation in March 1951.



GE Dedicates New Knolls Laboratory to Celebrate Fiftieth Anniversary of First Research Venture

New home of the General Electric Research Laboratory located at the Knolls near Schenectady, N. Y., was dedicated "to the advancement of scientific knowledge" by GE President Charles E. Wilson on October 9, fiftieth anniversary of the founding of the laboratory, first in the nation devoted to industrial research. Wilson presented a gold key marking the golden anniversary to Dr. C. G. Suits, GE vice president and director of research.

Honored guests at the ceremonies, attended by leaders of science, industry and government, included Dr. Willis R. Whitney, founder of the laboratory in October 1900 and its first director, and Dr. William D. Coolidge, X-ray pioneer and director emeritus. Now 82, and honorary vice president of General Electric, Dr. Whitney is still active in research. Dr. Coolidge, 77, is X-ray consultant.

Dr. Suits unveiled two heroic glass portraits of his predecessors as director of the research laboratory, Dr. Whitney and Dr. Coolidge. These are panels, each 33 by 57 in., set into the glass wall that forms the front of the entrance lobby to the main building. They were made by a new process developed by Corning Glass Works in which the photographic image is formed through the glass itself, and not merely applied as a surface coating. Dr. Suits also unveiled, at the entrance of the main building, a bronze placque, which expresses the appreciation of the research staff to President Wilson.

These events marked the beginning of a week-long program. This included in the annual autumn meeting of the National Academy of Sciences, held for the first time in its 88-year history at an industrial laboratory. The academy numbers in its membership leaders in American science, as well as eminent scientists from abroad.

The T-shaped main building is five stories high (first two below ground) and has 159,000 sq. ft. of usable floor space. It houses 107 laboratory rooms, an auditorium accommodating 325 persons, a penthouse for executive offices, another penthouse for weather research, and extensive shop areas.

Fourth and fifth floors of the newly completed wing, the cross of the T, house the Chemistry Division. The chemists are engaged in many researches, some concerned with combustion studies, others with new kinds of plastics. These rooms are well ventilated. Hoods are exhausted by ducts leading to a battery of blowers

(Continued)



JAPANESE GET BRIEFED ON U.S. RESEARCH

Operation of novel arc-melting unit used for production of titanium alloys is explained to Nobuyoshi Kato of Kyoto University, left, Yoshihiro Asami of Hokkaido University, center, and Yasushi Watanabe of Tohoku University, right, by Dr. Harold K. Work, director of the research division, New York University College of Engineering. The Japanese educators are making a tour of engineering colleges in the U.S. and are here under the Exchange-Of-Persons Program sponsored by the Department of the Army's Far East Command. The Institute of International Education planned tour.



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in a monitor, a special long structure above the fifth floor, and then through the roof to the open air.

"Universal space" design, provided by ready availability of services and use of movable steel partitions, permits establishment of laboratory rooms of any size from six feet to the full length of the building.

In addition to the main building, there are four other principal structures on the 180-acre tract. They are: the radiation laboratory, in which will be housed the new 300,000,000-volt synchrotron; the low-temperature laboratory, equipped to produce liquid helium, for experiments at temperatures near absolute zero (−460 deg. F.); a chemical pilot plant, for testing new chemical processes on a semi-production basis; and a heating plant. Including all buildings, about 180,000 sq. ft. of usable floor space is available.

The present laboratory, devoted primarily to fundamental research, now has a staff of over 800. About a quarter are scientists, with the rest providing technical, clerical and other assistance.

The GE Research Laboratory was established in 1900, when company officials recognized that they should provide some new source of fundamental scientific knowledge that could be applied to make the technology of the future, particularly in the electrical industry. The idea of a commercial firm engaging in fundamental research was then a novel one, as this had previously been done almost solely by academic scientists.

Dr. Whitney, then a brilliant young chemist at MIT, was selected to head the new laboratory. He started in an old barn in Schenectady in October 1900. At first he gave the work only half his time, and had one assistant, Tom Dempster, who was also present at the dedication exercises. From this small beginning has come the present laboratory. And now, on its golden anniversary, the goal of the nation's first industrial research laboratory is still fundamental scientific knowledge.

National Lead to Make More Titanium Dioxide in Jersey

Capacity for the production of titanium dioxide at the Sayreville, N. J., plant of National Lead Co. will be substantially increased by new construction just getting under way. The new buildings and equipment are scheduled for completion in 15 months.

This further expansion of the company's facilities is intended to meet the steadily growing demand for tita-

nium dioxide pigments for the current industrial mobilization program. Mindful of the critical shortage that developed during World War II, National Lead considers further expansion a necessity to maintain the supply of titanium dioxide, which has vital use in protective coatings, paper, welding rods, rubber, plastics and many other essential products.

Public Relations Topic at Meeting of Consultants

A symposium on "Public Relations and the Consultant" highlighted the Open Door Meeting of the Association of Consulting Chemists & Chemical Engineers, Inc., held on October 24 at the Hotel Shelburne, New York City. A slate of newly elected officers was also announced at this annual dinner meeting.

Paul B. Slawter, Jr., vice president of the House of J. Hayden Twiss, New York City, was the principal speaker. Moderator for the discussion was John Sasso, industrial production editor of *Business Week*, a McGraw-Hill publication.

New president of the association is Erwin Di Cyan, consulting chemist, Di Cyan & Brown; vice president, Earl D. Stewart, director of research, Schwarz Laboratories, Inc.; treasurer, Robert S. Aries, consulting chemical engineer, Robert S. Aries & Associates; and secretary, Albert P. Sachs, consulting chemical engineer. The incoming officers, who are all with New York City firms, will serve one year.

Named councilors, to serve three-year terms, were Charles L. Mantell, consulting chemical engineer; Nicholas M. Molnar, consulting chemist, Molnar Laboratories; Maurice S. Sage, consulting chemist, Sage Laboratories, Inc.; Frank A. Strauss, consulting chemist, Barsky & Strauss, Inc.; and Lincoln T. Work, consulting chemist. All of the new councilors are likewise affiliated with Manhattan organizations.

Phillips to Operate Both GR-S and Butadiene Plants

Phillips Chemical Co. has taken over operation of the government-owned synthetic rubber plant near Borger, Tex., it has been announced by the Office of Rubber Reserve. Phillips Chemical already operates the adjoining Plains butadiene plant, which that company designed and built for the government during World War II.

Substantial savings to the government are expected through operation of the synthetic rubber plant and the

(Continued)



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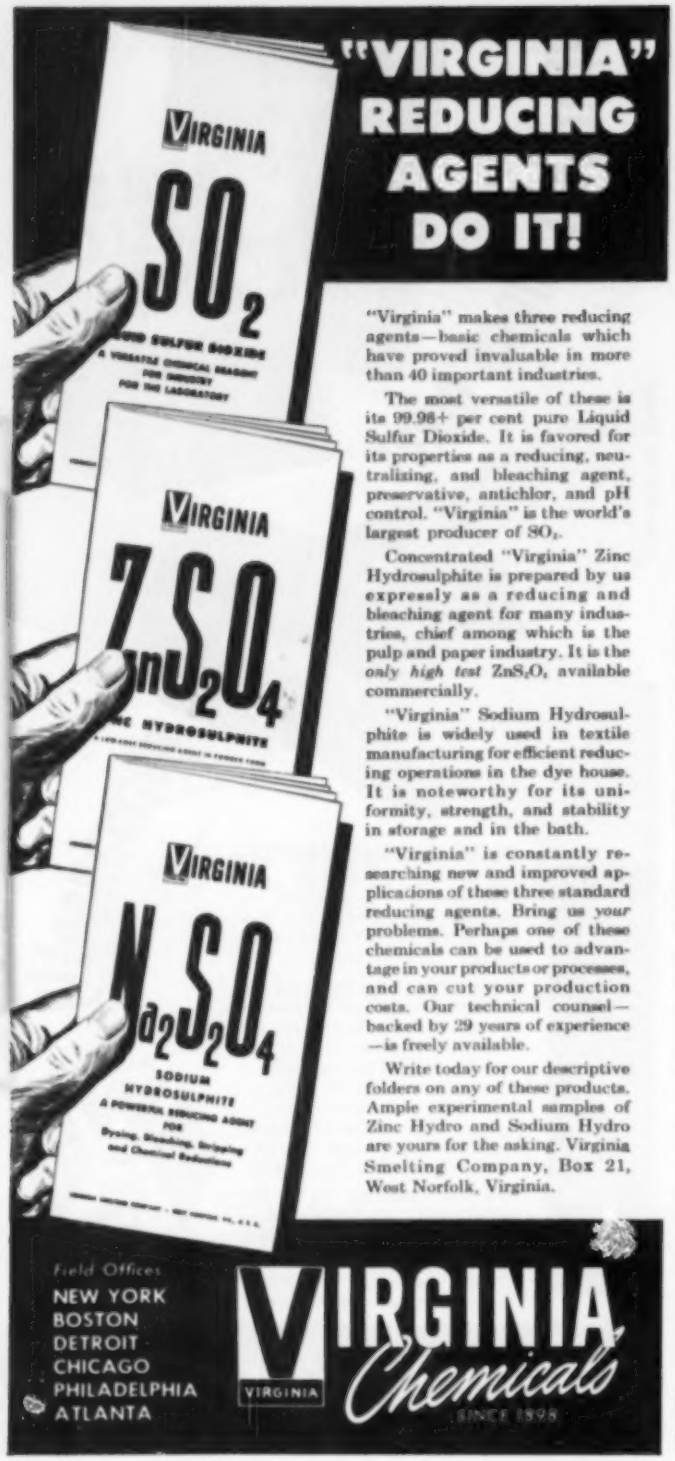
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adjoining butadiene plant as a combined unit. Because of the consolidation of the two plants a Rubber Division of Phillips Chemical Co. has been formed.

Compromise Avoids Strike At Corpus Christi Plant

Corn Products Refining Co. has been threatened by a strike at its Corpus Christi, Tex., plant. However, the management and union have agreed to a wage increase of 15 c. an hr. for some 300 employees, termed a compromise settlement by both groups, thus averting the strike.

Terms of the settlement are reported to include a 9 c. an hr. cost-of-living boost for each employee, and a correction-of-inequities boost, varying with jobs involved, which averaged 6 c. an hr. for each employee.

The union, Local 343, Oil Workers International Union, CIO, had asked the correction-of-inequities raise because wage levels at the plant did not match those offered in plants similar to the one at Corpus Christi.

Under the agreement the largest raise granted was 38 c. an hr. Top rates at the plant were fixed at $1.62 an hr. for production workers and $1.94 for maintenance men. This agreement is to run until June, 1951.

Phillips Plans Texas Plant For Output of Carbon Black

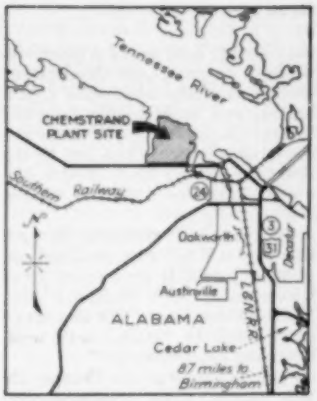
Increased production of carbon black, vital material in the manufacture of rubber tires, is promised by Phillips Chemical Co., which plans to build a new plant near Borger, Tex.

Construction is to begin soon, K. S. Adams, president of the company, announces. Completion is scheduled for 1951. The new plant, plus improved collection efficiency, is expected to raise production of carbon black from 90 million pounds a year to about 160 million.

Wage Boost Brings Peace to Alcoa's Point Comfort Works

A settlement has been reached in the month-long strike of 400 workers at the Point Comfort Works of the Aluminum Co. of America at Port Lavaca, Tex. Alcoa and Local 4370 of the United Steel Workers of America, CIO, have reached an agreement.

Basis of agreement is reported to be a 10 c. an hr. general wage increase, with pot-men and laborers receiving an additional 5 c. an hr.; increasing these two job classification rates a total of 15 c. an hr.



Chemstrand Chooses Site for Its New Acrylic Fiber Plant

Plans for the construction of a multi-million dollar plant to manufacture a new synthetic fiber for the Chemstrand Corp. have been announced by Monsanto Chemical Co. and American Viscose Corp., joint owners of the Chemstrand Corp. Plans call for the plant to be erected on a 656-acre site west of Decatur, Ala., on the Tennessee River.

Meantime, Chemstrand will shortly begin the operation of a synthetic fiber semi-production plant at Marcus Hook, Pa., where a million pounds of synthetic fiber staple will be produced annually. Up until now, the acrylonitrile-type fiber has been produced only in laboratory quantities.

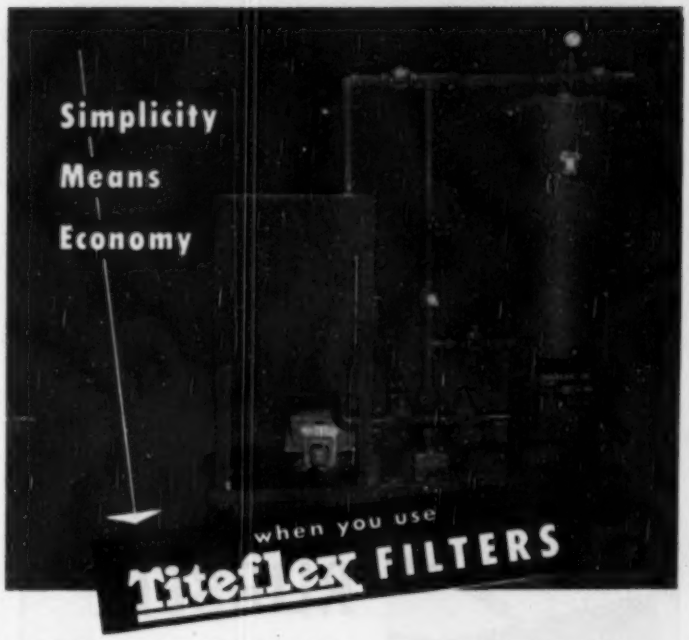
Size of the Alabama installation has not been disclosed; its construction will get under way next year. The plant site is bounded on three sides by the Wheeler Reservoir of the Tennessee River, and on the south by State Highway 20.

Chemstrand's new synthetic fiber will be manufactured only in staple form in its initial stages. The fiber has proved highly successful in early tests, and, because of its very low specific gravity, will tend to offer warmth in lightweight suitings.

Formation of the Chemstrand Corp. was announced May 5, 1949, by Monsanto Chemical Co. and American Viscose Corp. Dr. Carroll A. Hochwalt of St. Louis, a Monsanto vice president, is president of the new corporation.

Current plans for large-scale production in Alabama are the result of years of intensive research in the field of synthetic fibers. "Much of the important early work," says Dr. Hochwalt, "was accomplished at Monsanto's Central Research Department at Dayton, Ohio. American Viscose person-

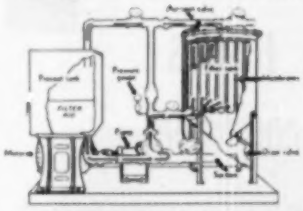
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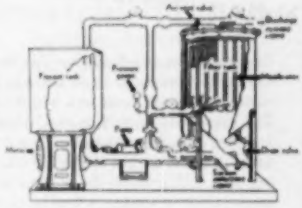
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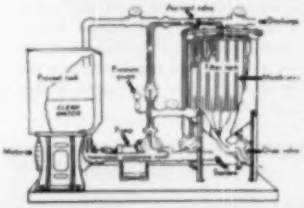
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nel, likewise, have played a major role in both research and development work. Particularly noteworthy contributions were made by the American Viscose Corp. Chemical Research Department at Marcus Hook and by the American Viscose Corp. Textile Research Laboratory, also at Marcus Hook.

"We have every confidence that our new fiber will add additional and important qualities to the growing list of fabrics made from synthetics," Dr. Hochwalt continues. "We also anticipate it will be blended with wool, rayon and other materials."

Announcement of the Decatur site and Marcus Hook semi-production plant ties in with Monsanto's recently disclosed program for the construction of an acrylonitrile plant at Texas City, Tex.

Officers of Chemstrand, in addition to Dr. Hochwalt, are Dr. Charles S. Venable of Philadelphia, director of chemical research for American Viscose, who is vice president of the new corporation, and F. William Koster, also of American Viscose, who is secretary-treasurer.

The following are members of Chemstrand's board of directors: William M. Rand of St. Louis, president of Monsanto; Dr. Charles Allen Thomas, also of St. Louis, Monsanto executive vice president; Dr. Hochwalt; Charles S. Cheston of Philadelphia, Monsanto board member; Dr. Frank H. Reichel of Philadelphia, chairman of the board and president of American Viscose; Edgar M. Queeny of St. Louis, Monsanto board chairman; Dr. Venable; Charles S. McCain of New York, president of Dillon, Read & Co. and a director of American Viscose; William Ewing of New York, partner of Morgan, Stanley & Co. and a director of American Viscose; and John G. Jackson of New York, partner of Jackson, Nash, Brophy, Barringer & Brooks, and member of the board of American Viscose.

Celanese Adds Facilities For Acetate Staple Fiber

New facilities for the production of acetate staple fiber are being erected at the Rock Hill, S. C., plant of Celanese Corp. of America as part of a program for rounding out manufacturing operations at the Celriver unit. Service facilities for increased chemical operations also will be provided.

"The corporation's continuing program for bringing into balance its productive units," President Harold Blancke says, "has been gauged to market demands. Accordingly, plant

operations have been planned with the dual purpose of providing an increasing flexibility of operations and of meeting changing market conditions. The new productive facilities now being installed at Rock Hill represent a fulfillment of that policy."

At present, the Rock Hill plant, which came into production in the final quarter of 1948, produces acetate filament yarn only. This year, additional equipment and machinery were installed for increasing filament yarn production and to provide greater flexibility of yarn shipping packages.

"The facilities to be made available for the production of acetate staple fiber at the Rock Hill plant will satisfy, to some degree, the prevailing record-breaking demand for that product," according to Blancke. "Opening up of new mass markets such as the men's clothing and floor-covering fields, together with greater demand from established consumer areas, have strained domestic acetate staple fiber capacity for a considerable time."

Last refinery in Titusville, Pa., once the oil capital of the world, ceased all distilling and processing operations on November 10. It is the Cities Service refinery, which has been purchased by Quaker State Oil Corp. It will probably be dismantled.

Water consumption has been cut at the Naval Shipyard, New York, with annual savings of $200,000. A six-month economy program involved accurate metering; repairing of leaks; overhauling of steam condensate return systems; use of cooling water from refrigeration and air-conditioning equipment as boiler make-up feed; and overhauling of drinking fountains and flushing systems.

Polyethylene film is the latest interest of Olin Industries, Inc. Olin has purchased a substantial interest in the Harwid Co. of Cambridge, Mass., manufacturer of polyethylene film. This interest in polyethylene film will complement Olin's sale of cellophane. A cellophane plant is now being constructed at the Pisgah Forest, N. C., plant of Ecusta Paper Corp., an Olin subsidiary.

Recycling plant, to cost $5 million, will be built south of Alvin, Tex., for Phillips Petroleum Co. Construction materials are arriving at the site now; Brown & Root, Inc., of Houston is the contractor on the job. In the three years since the recycling plant was first planned, Phillips has brought in several producing oil and gas wells southwest of Alvin. —End

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The Human Equation

RICHARD L. DEMMERLE, Associate Editor

Picking Foremen Means Picking Leaders—A Planned Approach Offers Best Chance

Once upon a time it was easy to pick a foreman. But that was back in the days when the ability to get out production was the sole criterion for appointment to that job. Worker-employer relationships bypassed the foreman's office and all the latter had to do was concern himself with pushing out products and checking time cards. It was an era in which foremen, adept in human relations, shone and were appreciated but rarely sought after for that skill.

But then two wars, a mushrooming of industry and a consequent growth of labor problems made the human factor in production the biggest single "must" in the modern foreman's long list of duties. In the short space of two decades, industrial evolution transformed the office of the straw-boss into an outpost of management. The foremost workman had become a first line supervisor.

The office and responsibilities of the supervisor expanded, however, faster than an understanding by management of what qualities were required in the foreman to discharge these responsibilities. The function of the foreman had broadened to include such duties as:

1. Rating of employees.
2. Participation in procedure for recommending increases and promotion.
3. Handling of grievances.
4. Cooperation in training of workers.
5. Collaboration in safety programs.
6. Participation in company welfare programs.
7. Cooperation in recreational activities.
8. Making recommendations on improvement of work methods.
9. Making analysis and suggestions for maintenance of cost standards.

Management began to realize that duties such as these required that the supervisor be an individual equipped with an appreciation and aptitude for human relations. Initiative, self-dependence and, an ability to meet and handle people supplanted trade skill and production-pushing as the major criteria on which foremen were picked. But the problem of how to determine and measure these qualities still had to be solved.

The selection of foremen is currently a much more painstaking job for production executives than it was even prior to World War II. In fact the appointment of supervisors is now considered by most companies to be too big a responsibility for one man to shoulder . . . juries or committees of plant or management executives must make the final decision. And these groups in turn often rely heavily upon suggestions made by professional consultants trained in the techniques of interviewing and the evaluation of personnel records. Further objective data are gained by the competent administration of personnel tests of a general type or specifically designed for the needs of the individual company.

The most usual planned approach to the selection of foremen consists of four steps:

1. Compilation of an employee appraisal sheet.
2. Evaluation of personnel records.
3. Conducting a patterned interview.
4. Administration of personnel tests.

Quite often this series of steps is preceded by a nominating technique in which employees and other supervisors take part. This announcement and an appropriate ballot procedure are carefully prepared with brief information on the requirements, opportunities and the selection procedure. In this system employees and supervisors submit names of candidates and those receiving the highest number of mentions are considered for further study by management.

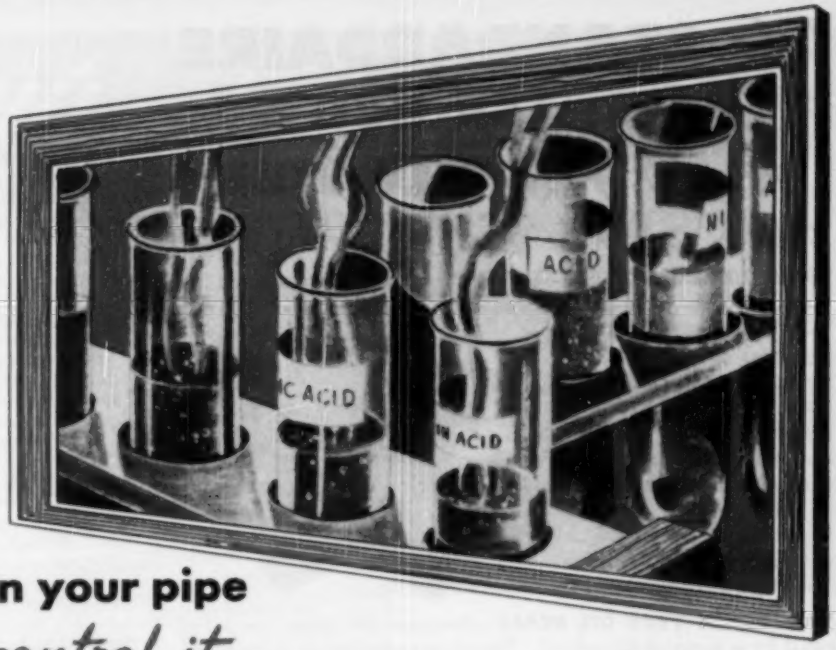
Management's appraisal sheet must provide information on the candidate's work habits, mental ability, adaptability, interests and personality. A good example of this type of form is the one published by R. S. Schultz of Industrial Relations Methods Inc. in the September 1950 issue of *Supervision*. It consists of 12 searching questions which must be answered about the candidate by several members of the supervisory staff.

1. Is he a thorough, persistent, conscientious and safe worker?
2. Is he always punctual, reliable, frank and dependable?
3. Does he quickly grasp ideas and instructions?
4. Does he have a good memory?
5. Has he been particularly eager to "help out" or put forth extra effort?
6. Has he demonstrated a strong desire to be a leader, to make suggestions, and to set a good example in his work?
7. Is he especially well liked by other employees and superiors?
8. Does he react satisfactorily to criticism and frankly admit mistakes?
9. Does he express himself clearly and convincingly for varied contacts with employees?
10. Are his attitudes favorable?
11. Does he have above average physical alertness and energy?
12. Does he have a cheerful, emotionally stable, confident, tactful, forceful and mature manner that will stimulate employees to respond willingly to his suggestions?

If a definite "yes" is the answer to these questions about the candidate it is then desirable to review his personnel record. This gives information on such items as length of service, specialized experience, attendance and earnings. By so doing the personnel record helps set the scene for the most important step of all in selecting foremen . . . the patterned interview.

In the charge of a trained person this interview can bring to light salient points about the candidate's make-up that might otherwise take years to discover. Most experts in interviewing technique believe that the best way to begin such an interview is to let the candidate talk informally about himself for 15 to 45 minutes, presenting his background and qualifications for the job in his own way. Leading questions by the interviewer should be avoided, but he can interject subtle comments that will cause the candidate to cover certain pertinent subjects. Schultz, in his article in *Supervision* suggests a convenient

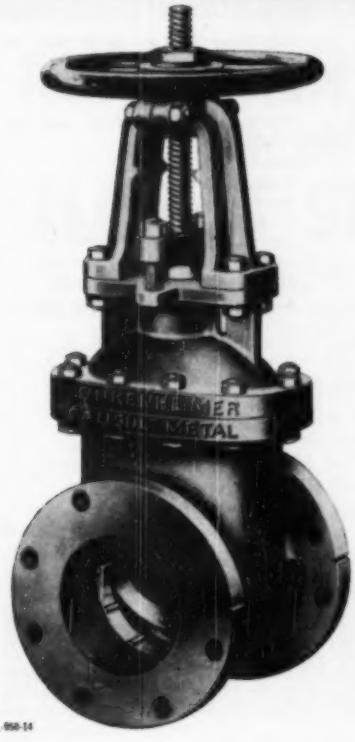
(*Continued*)



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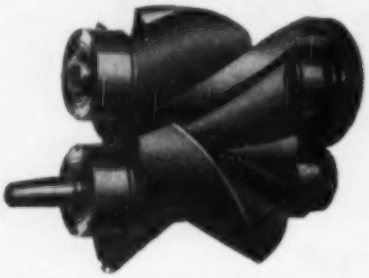
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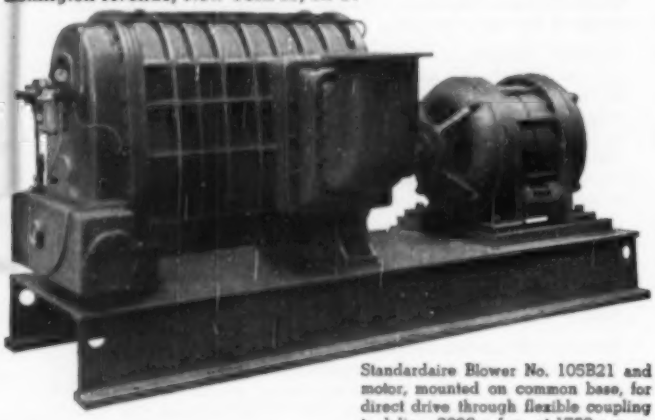
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HUMAN EQUATION, *cont. . .*

outline of points to be covered in such an interview.

1. Home background.
2. Education and training.
3. Experience, skill and special abilities.
4. Family situation.
5. Financial status.
6. Health status.
7. Social and recreational activities.
8. Interests and ambitions.
9. Attitudes (company, industry, profits, employees, supervisors, management, policies, rules).
10. Habits (personal and work).

But the patterned interview does more than give a "feel" of what type of person the candidate is. The factual results of the interview when properly evaluated and tabulated can be used to give an objective statistical picture of him that can be compared with those of supervisors that have already proved satisfactory.

For example, a major industry that figured prominently in production during World War II assayed their successful foremen and found they shared many background factors:

Background
- Age in first supervisory position—under 27 years
- Birthplace of one parent or self—United States

Education
- Schooling—two or more years of high school
- Trade—apprenticeship

Home
- Marital status—married, and for more than four years

Economic Status
- Automobile—owner
- Began to support self at age of 19
- Telephone—name in directory
- Home—own or rent house

Recreation—Community Activity
- Hobbies—active participation
- Membership in some organization—active, usually an officer
- Sometimes makes speech in public
- Participates in church or community affairs

Physical condition
- Height—above 5' 9"
- Weight—above 163 pounds
- General health—satisfactory

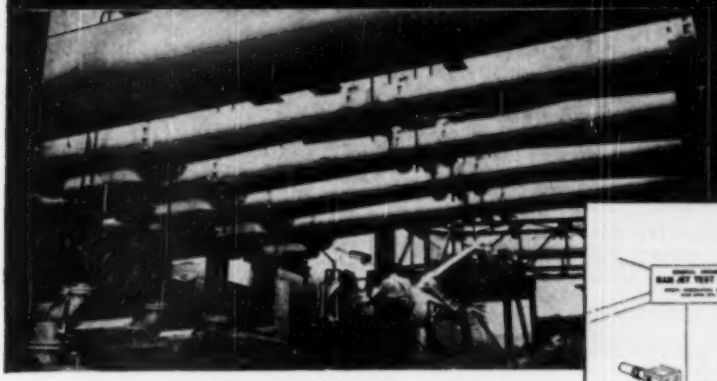
Experience and Training
- Some sales experience
- Previously in business or owner of business
- Can read blueprints

Admittedly, a strict emphasis on correlations between background factors, personal qualities and foremanship ability on an industry-wide basis may be too arbitrary for a given company to follow. But it is interesting to note that successful foremen do

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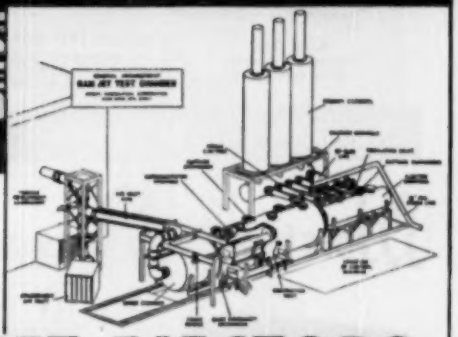
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The four ejectors which serve the ram jet test chamber

Drawing of the test setup. The engine is visible through the cut-away section of the test chamber. Ejectors in right background.



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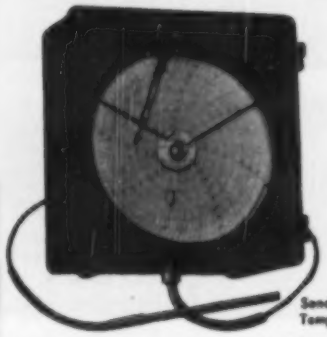
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seem to share the attributes of initiative and personal stability.

Cheerfulness and a wholesome attitude toward his work and life in general also seem to characterize the successful foreman. Perhaps this is because a leader is always expected by his subordinates to convey a feeling of "it-can-be-done" and "it's-worth-the-doing."

The determination of the candidate's attitudes therefore, is an important part of the selection procedure. One way of getting a quick glimpse of these attitudes is by a short "yes-no" type of questionnaire.

Personnel tests constitute the fourth step in a planned selection of supervisors. In recent years these tests have received increased attention as an objective method of appraising the suitability of candidates for supervisory posts. In many cases standard tests can be used for the measurement of mechanical aptitudes, office work abilities, measurement ability and blueprint reading ability. But in other instances it is necessary to design specific tests built around the unique needs of the positions to be filled.

Regardless of the adequacy of the methods by which foremen are selected, the cause of good supervision is lost unless the candidates chosen are trained and developed toward their new responsibilities. Training program vary from company to company but even the simplest must include adequate instruction on five important subjects:

1. Responsibilities and duties of the foreman.
2. Essentials of company labor relations, personnel policies and practices.
3. Operating problems and solutions.
4. Employee job instruction.
5. Maintenance of employee cooperation and discipline.

These training programs can be conducted without lengthy preparation under the direction of an experienced senior supervisor or the principal assistant to the plant or production manager. Larger organizations often maintain training directors and staffs to run courses on supervision.

It does seem that a combination of a sound selection procedure with a planned training program is the best way to secure good first line supervision. But even the experts admit that such systems are not perfect . . . they merely increase the batting average. In the last analysis it's that rare, elusive but needed sense of responsible leadership that marks the man who is fit to direct the efforts of his fellows. —*End*

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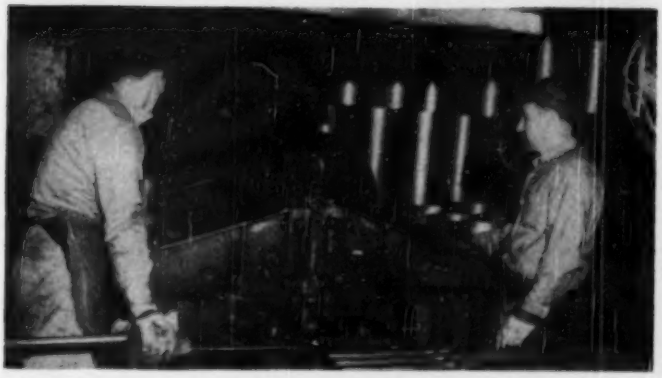
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Chemicals must reach customers in good condition so side seams are flash welded.



To provide strength, heads for these light gage steel drums are flanged and stamped.



To insure proper sealing for liquid chemicals, heads and bottoms are double seamed.

Packaging Notebook—VII

METAL DRUMS

Light gage steel drums, used for transporting liquids, vary in capacity from 5 to 55 gal. They are ordinarily used as single trip containers by the first filler, but his customer may reuse the containers for packing his own products if they are not classed as "dangerous" by the ICC, he may sell the drums to a local reconditioner, or in some instances the drums are returned to the original shipper for credit. Although these containers are tailor made to the specifications of each user there is considerable standardization in the 55 gal. size fabricated from 18 or 16 gage steel. Variations in diameter and height although slight, are due to the differences in diameter of the dies of the individual drum fabricators. Location and size of openings are usually specified by the purchaser. The Bureau of Standards is now preparing recommendations for standardization of heights, diameters, chime depths, height of rolling hoops etc. This, if adopted, would not only prove of benefit to firms who ship their products in drums but to steel sheet mills as well.

These drums, fabricated with flash welded side seams, have their heads double seamed in the conventional manner. Recently, a continuous electric resistance side seam lap welder has been adopted by a few manufacturers.

All steel drums used for transporting non-dangerous liquids by rail must be fabricated to comply with the Consolidated Freight Classification Committee's Rule 40, Sec. 5C. These containers may be used for multiple trips—there is no specification for a single trip container for non-dangerous liquids as there is for dry materials.

If the compound is dangerous as classified by the ICC then the regulations of CFC Rule 40 are superceded by the ICC specifications. These ICC containers of 16 and 18 gage are authorized for one trip when carrying dangerous compounds but may be used again for transporting

(Continued)

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Testing for leaks in welded side seams is an essential step in fabrication.

PACKAGING, *cont. . .*

non-dangerous articles. Although they are embossed S. T. C. (single trip container) this only applies to their use as containers for transporting those products classed as "dangerous" and for which these regulations permit the use of these drums.

During World War II when steel drums were in short supply, the ICC authorized reuse of these single trip drums. This authorization was limited to specific authority for reuse issued to each shipper for each dangerous commodity by the Bureau of Explosives and based on the shippers performing certain specified tests before each filling. Some months ago, the bureau recommended that this emergency reuse authorization be cancelled because the need for it had disappeared. Approval of this request was delayed by opposition of drum reconditioners and others, until the current condition of short supply developed. At the present time the proposal for cancellation is being reconsidered and it appears likely that action on this motion will be deferred. It may be that further restrictions on use may be imposed or additional tests may be required.

The full open head construction, ICC Spec. 17H ordinarily requires that 14 gage steel be used in the removable heads although the use of 18 gage is permitted for the bottoms and cylinders.

As in the case of the lighter gage drums of this construction the Steel Shipping Container Institute and the Manufacturing Chemists Association's Steel Shipping Container Committee have devised means for strengthening this closure. Changes have been made in the shape and curl of the head as well as in the ring. This new specification was adopted in 1947 after considerable testing conducted by the Bureau of Explosives and these two associations. Those details of construction contained in this specification which are designed to increase the strength of the closure are: (1) Closing rings for drums of over 5 gal. capacity must be of 12 gage steel having drop forged lugs and ¾ in. bolts and nuts. Leverlock types are

(*Continued*)

Rules for Filling

☐ Type Drum	☐ Limits
Rule 40 Sec. 8C	No limits prescribed
ICC Spec. 17C, 17E, 17F, 17H Up to 30 gal.	Min.: rated capacity +2% Max.: rated capacity +2%+1 qt.
Over 30 gal.	Min.: rated capacity +2% Max.: rated capacity +2%+1 gal.
ICC Spec. 17X	Min.: rated capacity +2% Max.: rated capacity +2%+1 qt.

Rules for Wall Thickness: General

Gal. Capacity	Gage
Under 5	26
5–7	24
7–10	22
10–20	20
20–35	19*
35–58	18†
58–75	16
75–110	14
110–168	12

*20 ga. authorized; †18 ga. bodies and 20 ga. heads authorized.

Rules for Wall Thickness: Dangerous Liquids

ICC Specifications for Single Trip Drums

Rated Capacity, Max. Gal.	ICC 17C	ICC 17E	ICC 17F	ICC 17H Bodies	ICC 17H Heads	ICC 17X
5	22	24		24	20	
10	20	22				
20	18	19*		19	18	19
55	16	18†	16	18	14‡	18

* 20 ga. authorized; † 20 ga. heads authorized; ‡ 16 ga. authorized having one or more corrugations in head near periphery.

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Readco Vertical Mixing Tanks are supplied with stationary tank capacities of from 30 to 1000 gallons.

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permitted only when authorized by the Bureau of Explosives after proof of their ability to pass the specified tests. (2) Drums of 55 gal. capacity must have an expanded hoop in the body near the top curl. This is designed to stiffen the top of the drum as well as cushion the impact from the drop test and is in addition to the conventional expanded hoops used for rolling the container. (3) Full open heads for the 55 gal. size must be fabricated of 14 gage steel. If one or more corrugations are pressed into the cover near the periphery 16 gage steel may be used.

Openings in tight head drums are of the pressed in type. Some of these flanges use gasketing compound to seal the joint of the spud with the drum metal. There are several types of openings from which to choose, each of which has certain construction features. Most can be sealed with conventional cap seals to prevent leakage and pilferage or wire seals to prevent pilferage. Standard sizes of openings are ¾, 1-¼, 2 in. and any combination of these sizes can be used. They can be placed in the drum at the most convenient locations.

Usually the drums are equipped with a 2 in. filling opening and a ¾ in. vent. If both openings are located in one head the cost of the drum is less. Most flange manufacturers have specialties which have been designed to solve particular problems, such as faucets and agitators which can be attached to the underside of drum plugs. They also have special wrenches for use with their plugs. There are a few universal wrenches on the market for which it is claimed that they will handle all types of plugs. Powered wrenches are available for use where the volume warrants such installations.

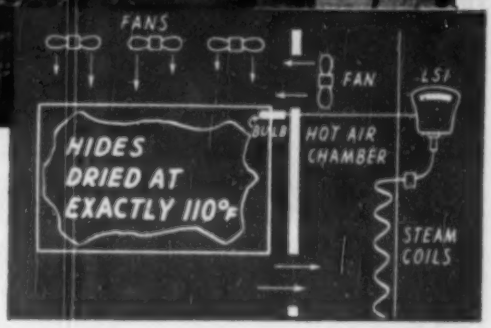
The markets for steel containers of this type are being rapidly expanded by the introduction of new coatings and by improvements in lining application. Over three years ago the Steel Shipping Container Institute employed the Battelle Memorial Institute of Columbus, Ohio, to study this problem. The program has proved to be so successful that it has been placed on a basis of continued research for the steel shipping container industry. The work has included (1) a study of steel surfaces including preparation of steel prior to application of linings, (2) evaluation of linings, and (3) development of most effective methods of lining. The findings of the investigation will be included in recommendations cov-

(Continued)



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for this Sarco Controlled Drying Operation



SARCO PRODUCTS FOR FOODS AND CHEMICALS



Thousands of dollars worth of hides pass through drying chambers every day, in this New England Tannery plant. Who can watch the thermometers and run around turning valves fast enough to prevent the hides from "burning"? Who knows whether the equipment has been run at top capacity with a minimum of precious fuel used?

No human being can claim perfection on a job like this — but Sarco can, and proves it every day on a score of different kinds of drying operations in a dozen industries.

In the plant illustrated, the inexpensive Sarco LSI increased production with the same equipment and operators — and without losing hides due to incorrect drying temperatures.

IN YOUR PLANT it may be a temperature control on hot water or a few dollars spent for individual traps on every steam coil that will boost production with less fuel, and insure a better, more uniform output. A few of the Sarco Products that do just that are shown at the left. Send us a sketch of your heating processes or ask to have the Sarco man near you look over your plant.

309

SARCO

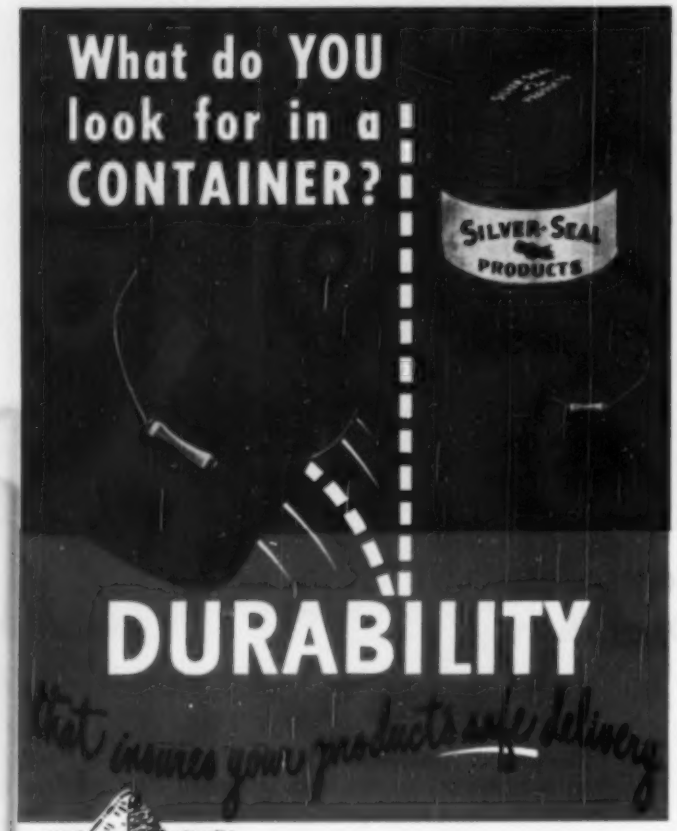
SAVES STEAM

SARCO COMPANY, INC.

Represented in Principal Cities

Empire State Building, New York 1, N. Y.

SARCO CANADA, LTD., TORONTO 8, ONTARIO





—one of 6 essentials you're sure of with Inland Steel Containers

You can't beat the durability of steel to stand up under all the use and abuse of shipment and storage. Give your products this protection — this *insurance* — by shipping them in Inland Steel Containers.

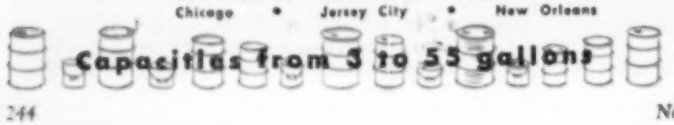
But durability is just one of six big factors that make Inland your best container source *for any product!* Inland also gives you . . . *full-color lithography* that makes every container a "salesman" . . . the *leakproof strength* of Inland design . . . a *variety of closures* to meet every need . . . *protective Hi-Baked Linings* for special product problems . . . and selection from a *line that is really complete.*

Be sure of all six essentials when you buy. Specify Inland Steel Containers . . . from our standard line of Drums and Pails . . . or submit your special problems to our engineering staff.

A-3

INLAND STEEL CONTAINER COMPANY

6532 South Menard Avenue • Chicago 38, Illinois
Chicago • Jersey City • New Orleans



ering specifications for lining drums.

Manufacturers have already made changes in methods used in spraying linings, spray equipment has been altered and changes have been made in baking temperatures and oven temperature controls. Already, improvements in lined drums can be noted and further improvements will be forthcoming as fabricators are able to change their production procedures to incorporate additional findings of this research program.

There is now a venting plug available for use in closing drums holding compounds that develop internal pressures. This plug, developed for use on sulphuric acid drums shipped by water, has a porous carbon core through which gases can permeate. It has proved effective for exports of sulphuric over a period of two years.

For many years there were few changes made in the construction of steel drums. The situation has changed however since the last war. As a result of intensive research, much progress has been made. As this work is continuing even more beneficial changes are in the offing. Much of the credit for these accomplishments belongs to L. B. Keplinger, president of the Steel Shipping Container Institute, who has been ably assisted by W. I. Handrahan, chairman of the institute's specification committee, and Lawrence MacKay, chairman of their research committee. The metal packages committee of the MCA under the chairmanship of George Sands has cooperated fully in the development of the research program and have actively participated in some of the work.

Aluminum Pull Up Spout Speeds Pouring

A new impact extruded aluminum pull-up spout with built in vent provides an opening for fast filling of pails and cans. The nozzle has a 2½ in. dia. opening and the spout can be inserted after filling.

The seamless tapered spout has a 1½ in. opening. When in pouring position it forms a liquid tight joint that is strong enough to rest the full can on while pouring. The vent allows pouring in an even stream without surging.

The inner seal is a friction cap which is pried out after the outer cap is removed. The outer cap can be of the screw or U-Pressit type. This closure is manufactured by R. W. Shore Mfg. Co. Inc., 33-17 37th Ave., Long Island City, N. Y.

—*End*

IT MUST BE *Continuous!*



The Steady Grind of the Six-Day Racer

Processing, too, must be continuous to fit in a modern production schedule. Centrifugal force, employed to best advantage in a De Laval Separator or Clarifier, removes the cause of interruption from many a process that formerly was ***not*** continuous.

De Laval machines separate two liquids, or remove solid contaminants from either one or two liquids, in a matter of seconds. Where the job calls for the continuous removal and continuous discharge of solids from one or both liquids, that, too, can be accomplished by one of the De Laval "Nozzle-Matic" group of machines. The "Nozzle-Matic" Separators are available with various bowl and cover modifications to fit various requirements.

There is another good reason for letting De Laval solve your problems of separation or clarification. De Laval has solved so many problems of separation in its many years of experience that one quite similar to yours may already be in the files. It will pay you to ask.

THE DE LAVAL SEPARATOR COMPANY
165 Broadway, New York 6 · 427 Randolph St., Chicago 6
DE LAVAL PACIFIC CO., 61 Beale St., San Francisco 5
THE DE LAVAL COMPANY, Limited, Peterborough, Ont.

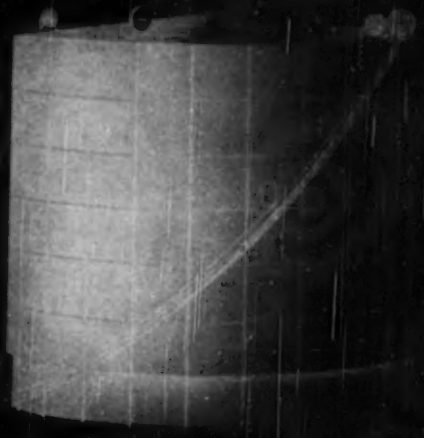


De Laval



the First Name in Centrifugals
the First Thought for CONTINUOUS
SEPARATION · CLARIFICATION · CONCENTRATION

Wiggins Gasholder



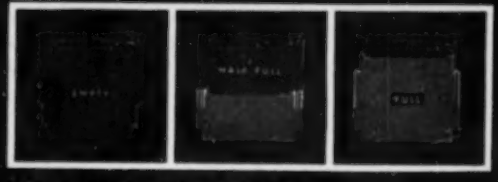
the **only** gasholder that uses

NO **WATER**
TAR
GREASE

the **only** gasholder with

AN ABSOLUTELY DRY, FRICTIONLESS SEAL

the **only** gasholder that assures



NO **WEATHER WORRIES**
OPERATING COSTS
MAINTENANCE PROBLEMS

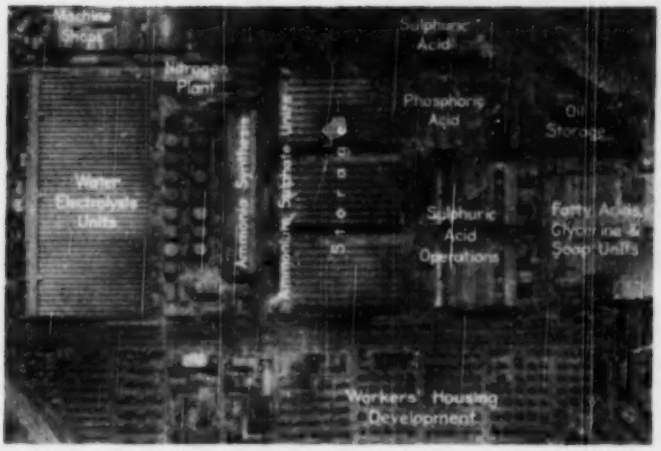
Operates at pressures up to 20" of water. Gas tightness and impermeability of the Wiggins dry seal proved in 15 years' service under actual operating conditions. Ask about converting your present gasholders to the Wiggins principle.

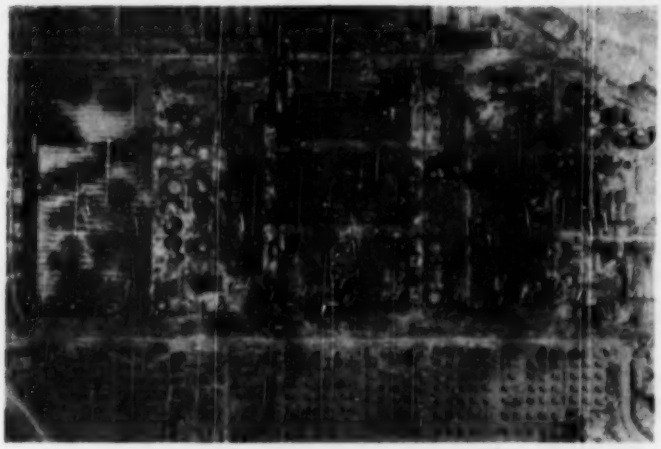
WIGGINS VAPOR SEALS GENERAL AMERICAN

GENERAL AMERICAN
Transportation Corporation
135 SOUTH LASALLE STREET • CHICAGO 90, ILLINOIS

News From Abroad

SPECIAL CORRESPONDENCE





McGraw-Hill's ALPHEUS W. JESSUP reports directly from Korea on the destruction caused as a direct result of the Red invasion. The on-the-spot coverage is made possible by Jessup's permanent assignment as Chief of McGraw-Hill's Tokyo Bureau.—EDITOR.

Red Aggression Causes Destruction of Korea's Chemical Centers

Tokyo—One of Asia's greatest chemical works has been wiped out by United Nations bombers during the Korean war. The fertilizer, carbide and explosives plants at Konan (Hungnam) on the east coast of North Korea were strategic targets for B-29s and for Navy carrier based dive bombers.

Engineers of the Shin Nippon Nitrogenous Fertilizer Co., Ltd., the Japanese company which built and operated these plants until Japan's defeat in World War II, estimate that 90 percent of the facilities are destroyed. Reconstruction will cost well over $100,000,000.

Primary output of this industrial complex was fertilizer; it was the biggest single producer of chemical fertilizers in the Orient and one of the biggest in the world. Its capacity was something over 500,000 metric tons of ammonium sulphate annually under Japanese management; and plans were underway in 1944 to add 145,000 tons. About one-half was shipped to Manchuria, China and Formosa. The remainder was utilized in Korea and Japan.

In 1944, the last full year of Japanese management, the three main plants produced:

	Metric Tons
Sulphuric acid	470,000
Ammonium sulphate phosphate	120,000
Ammonium sulphate	500,000
Ammonia	120,000
Nitric acid (48 Be.)	2,500
Nitric Acid (98%)	2,600
Ammonium nitrate explosive	6,000
Carbide	180,000
Calcium cyanimide	58,800
Acetone	900
Acetylene black	3,200
Iso-octane	18,000
Aldehyde rosin	700
Contact sulphuric acid	10,000
Carbon electrode	8,400
Phosphoric acid	5,000
Superphosphate	35,000
Ammonium chloride	10,000
Soda ash	10,000
Caustic soda	15,000
Hydrogen chloride	12,000
Hydrochloric acid	10,000
Bleaching powder	22,000
Hardened oil	25,000
Glycerine	2,000
Fatty acid	32,000
Soap	18,000

Konan consisted of three main plants: the fertilizer factory, the explosives plant and the Bogun chemical plant. Key unit was the fertilizer factory.

It included 10,000 water electrolysis cells and eighteen 1,500-hp. ammonium synthesis compressors. Besides sulphuric acid and fertilizer, it produced phosphoric acid, fatty acid, glycerine and soap.

The Bogun plant produced, caustic soda, chlorine and carbide. The explosives unit produced nitric acid and 6,000 tons of ammonium nitrate.

All of the plants drew on 400,000

kw. of hydroelectric power. The Japanese company began its Korean development program in 1926. It first built up the hydro power plants in the mountains northwest of Konan. Then it built the fertilizer plant.

In addition to the chemical works, the company operated a small smelter and associated installations which produced: lead, zinc, copper, aluminum (4,000 tons), synthetic jewels, magnesia clinker and magnesium.

Russian engineers took over the plant in August 1945 when Soviet troops occupied North Korea. The manager was a Colonel Gregorief, who had been manager of superphosphate plant near Moscow. The colonel left in March 1946, and the remaining Russian engineers in April and May of that year when management was turned over to the Koreans. The Japanese engineers, one of whom escaped from Konan in December 1946, rated the Russian engineers as poor, although Gregorief was a good engineer.

In December 1946, the plants were in pretty fair condition. These were operating at a little less than half capacity. But with minor repairs and raw materials could be brought back to 1944 production quickly. There were 15,000 workers on the Konan payrolls. About half the pyrite, and all the salt, phosphate rock and oil were imported. Otherwise Korean sources were used for raw materials.

Canadian Distillery Builds Waste Recovery Plant

Ottawa—A cereal products plant for the complete recovery of distillery waste is under construction at the Walkerville, Ont., plant of Hiram Walker & Sons Ltd. Estimated cost is $1.5 million. The new unit will be located at the company site on the Detroit River, should be completed by summer, 1951.

The byproducts will be dark distiller's grains and solubles, feeds of the protein concentrate type. Total daily recovery will approximate 100,000 lb. This is double the present byproducts capacity of the distillery.

Wanted: More Engineers For Canada

Ottawa—In the event of war, Canada will experience a serious shortage of engineers, according to a Technical Service Council report on the present employment situation.

Record-sized graduating classes in 1949 and 1950 have been absorbed and there is a sustained demand for experienced men in many branches of the profession. In August, the number of requests for engineers showed a 58 percent increase over the same month last year. Although these figures are inflated by defense projects arising from the Korean situation, they also reflect the industrial growth of the country.

Dutch Use SO_2 and Rubber To Get Yarn

Amsterdam—The Royal Dutch-Shell Laboratory at Amsterdam has developed a textile yarn on the basis of a reaction between natural rubber and sulphurous dioxide, and using a wet spinning process. The yarns have a tensile strength approximately equal to good viscose rayon and can be manufactured of the same fineness as current acetate and viscose yarns. Tensile strength of the wet material is 80 percent of the air-dry yarn. The rubber yarns can be dyed with basic and acetate dyes. The material is remarkably resistant to many organic solvents and to many organic and inorganic fatty acids.

Alcohol Plant Completed In Dominican Republic

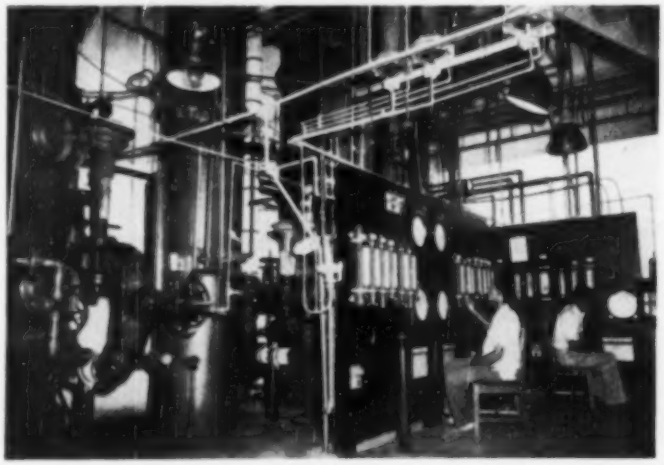
Ciudad Trujillo—A $600,000 plant for the production of absolute ethyl alcohol from molasses has been completed in Ciudad Trujillo. Output will be used for blending with gasoline, of which the country consumes about 15 million gal. annually.

The plant, known as La Destileria Universal, has a rated capacity of 7,200 gal. per day, or 2,500,000 gal. per year from 6,500,000 gal. of blackstrap molasses. It has been operated at 25 percent above its rated capacity. Provisions have been made for the future doubling of the capacity of the unit at minimum cost. Equipment has been installed to produce run over the absolute alcohol capacity.

Designed for maximum economy of operation, a distinctive feature is the generation of electricity from steam being used in the process. The plant used benzene for the dehydration of alcohol and is completely equipped for automatic operation. Buildings are designed to afford protection against earthquakes, and winds with a velocity of 180 mph.

Described as one of the most modern in the West Indies, La Destileria Universal occupies an area of 15,000 sq. yd. on the banks of the Ozama River, which will suppy the 1,200,000 gal. of water needed daily to cool the distilling equipment. The water reaches the plant through a surface pipeline with modern pumping equipment. Another pipeline leads from the plant along the river bed to the east bank. Through it the molasses is pumped from boats owned by the sugar mills.

Jointly financed by Dominican and American capital, the plant was designed by Kohn & Pechenick, Brooklyn, N. Y., with R. S. Aries & Associates, New York, as consultants. While building was under the supervision of U. S. engineers and technicians, Dominican labor was used in all other phases. (Continued)



Fractionating columns prepare alcohol for benzene treatment at this new absolute alcohol plant in the Dominican Republic.

For any commercial application requiring a

Glassy Sodium Phosphate

SPECIFY...



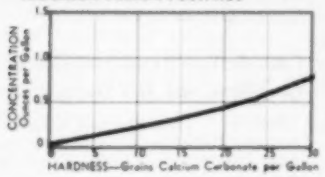
BLOCKSON SODIUM POLYPHOS*

(Sodium Hexametaphosphate)
(Sodium Tetraphosphate)

★ **In Sodium Polyphos, Blockson provides a water soluble Glassy Sodium Phosphate of standardized composition in the middle of the glass forming range of Sodium Phosphates . . . for use in all commercial applications where Glassy Sodium Phosphates are indicated. Ground and lump sizes. Mail coupon for bulletin and sample.**

EMPIRICAL FORMULA: $Na_5P_3O_{10}$
COMPOSITION: 1.7 Na_2O: 1 P_2O_5
STRENGTH: P_2O_5 63.5%; pH of 1% solution is 7.2
SOLUBILITY: 150 parts in 100 parts of water at 75° F.

Sequestration and Water Softening Capacity
BLOCKSON SODIUM POLYPHOS



WATER SOFTENING—SEQUESTRATION Precipitation of calcium and magnesium salts, which normally occurs with increased temperature or alkalinity, is inhibited when minute quantities of Sodium Polyphos are added to hard water. Larger additions prevent precipitation by *forming inert complexes** with the hardness elements. Precipitates already formed will re-dissolve. These complexes won't react with soap added to cleaning bath or formed by saponification of greases and oils by alkaline detergents. Sticky, fabric-enmeshing and equipment-clogging soap curds are avoided. THUS SODIUM POLYPHOS IS A VALUABLE ADJUNCT TO EVERY DETERGENT OPERATION.

*Also forms inert complexes with metallic ions of iron, copper, nickel, manganese and zinc.

DISPERSION — Sodium Polyphos exhibits to a remarkable degree the property of increasing dispersion of finely divided solids in a liquid medium. Typical applications include: dispersion of clay for coating papers, reducing viscosity of muds for drilling oil wells, water suspension of organic pigments. These, and the listing below, may suggest experimental application to your own particular problem.

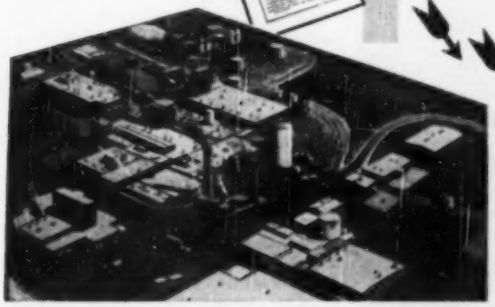
OTHER KNOWN USES — Industrial and municipal water treatment: for preventing scale formation, iron precipitation, and for corrosion control. Boiler compounds, dishwashing and detergent compounds, processing and dyeing of textiles, leather tanning, photographic film developing, flotation and desliming of minerals.

FOR FURTHER DATA AND SAMPLE MAIL COUPON



OTHER BLOCKSON CHEMICALS

- Sodium Tripolyphosphate Anhydrous
- Tetrasodium Pyrophosphate, Anhydrous
- Sodium Silicofluoride
- Sodium Fluoride
- Trisodium Phosphate, Crystalline
- Chlorinated Trisodium Phosphate
- Trisodium Phosphate, Monohydrate
- Disodium Phosphate, Anhydrous
- Disodium Phosphate, Crystalline
- Monosodium Phosphate, Anhydrous
- Monosodium Phosphate, Monohydrate
- Sodium Acid Pyrophosphate
- Light Alumina Hydrate
- Gloss White
- Sulfuric Acid



On this 200-acre site, an hour from the nation's railway hub, the vast BLOCKSON organization is coordinated into a closely knit group under intimate executive supervision for prompt service to American industry, large and small.

BLOCKSON
CHEMICALS

*Sodium Polyphos is a brand name

BLOCKSON CHEMICAL CO., Joliet, Illinois
Send bulletin on Blockson Sodium Polyphos
Include sample: ☐ Ground ☐ Lump Walnut ☐ Lump Pea

Name..... Title.....
Company..... Street.....
City..... Zone..... State.....



Believing that a good record of achievement is a true indication of ability, we are proud to show the extent of our accomplishments in designing and building Goslin-Birmingham Evaporators. The list of installations now in successful operation includes the following—

SIZES: 100 sq. ft. to over 60,000 sq. ft. heating surface.

TYPES: Long Tube Vertical Film, Long Tube Recirculating, Forced Circulation, Horizontal Tube, Falling Film, Short Tube Calandria.

MATERIALS OF CONSTRUCTION: Steel, Stainless, Nickel, Cast Iron, Copper and Copper Alloy, Lead.

USES: Sugar, Kraft and Soda Black Liquor, Citrus Press Water, Distillery Wastes, Alumina, Steepwater, Caustic, Salt, Sodium Sulfide, Steffens Filtrate, Pineapple Press Water, Glucose, Tank Water, Sulfite Waste Liquor, Sodium Sulfate.

If your problem involves evaporators, or other standard or special chemical process equipment, you can save yourself a lot of headaches by enlisting the aid of G-B's staff of experienced engineers, and by placing your order where sole responsibility for design, construction and final operating results is concentrated in one reliable organization.

Years of experience have developed within the G-B organization the "know how" for solving evaporator and other problems in the chemical process industries. And G-B's service program of periodic calls by capable and experienced engineers insures peak performance of the installed equipment.

Your inquiry for details on any G-B equipment will receive prompt attention.

PARTIAL LIST OF G-B PRODUCTS
EVAPORATORS • FILTERS • FLAKERS • CAUSTIC POTS
CONDENSERS • LARGE SPECIAL CASTINGS

and many other items of standard and special chemical process equipment.

GOSLIN BIRMINGHAM MANUFACTURING CO., INC.
BIRMINGHAM 1, ALABAMA
NEW YORK: Goslin-Birmingham, 350 Madison Ave.
CHICAGO: F. M. deBeers and Associates, 20 N. Wacker

Britain Starts Producing Styrene Plastic

London—Styrene plastic production at the new Lustrex plant of Monsanto Chemicals Ltd. in Newport, South Wales, is expected to relax restrictions on its home market uses. Until now, British industry has had to depend on the United States and Canada for large-scale sources of the plastic. Importation was conditional upon 90 percent of the end products being made for export. The new plant also will allow increased exports and a valuable dollar saving in the sterling area.

Initial production of British Lustrex was based on styrene monomer imported from the United States. Because this is now in tight supply due to the rubber program, other sources are being developed in Europe. Long term requirements are expected to be met by a new styrene monomer plant to be erected by Fourth Chemicals Ltd. at Grangemouth, Scotland. Monsanto Chemicals Ltd. and British Petroleum Chemicals Ltd., the latter a jointly owned subsidiary of Anglo-Iranian Oil Co. and the Distillers Co., are jointly associated in the recently-formed Chemicals Ltd.

Canada Ups Synthetic Rubber Gasoline and Oil Output

Ottawa — Canadian Oil Refineries and the Canadian government's synthetic rubber company, Polymer Corp., are planning expansions totalling $25 million. Both will build near Sarnia, Ont.

Authorization of a $6,600,000 expenditure by the Polymer Corp. has been announced by Trade and Commerce Minister Howe. Booming crude rubber prices and defense plans, he says, justify an increase of between 20 and 25 percent in the plant's 130,000,000-lb. rubber producing capacity. Three plants producing butyl, styrene and butadiene are involved. All are scheduled for completion within a year.

Two miles away, Canadian Oil Refineries, a subsidiary of Canadian Oil Cos., will build a refinery to process Alberta crude oil. It will produce an annual 105,000,000 gal. of gasoline as well as diesel, stove, furnace and heavy fuel oils. In addition it could supply butylene and ethylene to the nearby Polymer Corp. The $18 million expansion program also provides for erection of storage tanks to hold 900,000 bbl. to augment the present 365,000-bbl. capacity.

The company's smaller refinery at

Petrolia, Ont., 16 mi. from the site of the new plant, has been getting its supply of crude oil from the United States. As soon as the 1,150-mi. pipeline from the Prairies is completed next spring, it will switch over to Alberta oil. After the new refinery is built, use of Canadian oil instead of United States crude will save $17,500,000 a year in United States funds.

West Germany to Get New Refinery

Frankfurt – The ECA mission to West Germany has announced approval of the release of $550,000 from Marshall plan funds for the construction of a new refinery at Lingen in the Emsland area. It will have a topping capacity of 600,000 tons a year and a cracking capacity of 360,000 tons. Production is expected to reach 1,100,000 tons a year by the end of the Marshall Plan in June 1952.

Money for the plant will be made available by ECA to cover the costs of engineering services and the purchase of equipment at 36 million DM. Additional financing will come from the federal government's investment program and the Gewerkschaft Erdoel-Raffinerie at Lingen, which filed the request for financial assistance.

At present, Ems crude oil is processed in the hydrogenation plants at Wesseling and Gelsenberg. Due to the extreme heaviness of the crude oil and the distance of the processing plants, the method has proved very expensive. German oil experts have estimated that a refinery in the Lingen area will enable them to save about 4,800,000 DM. per year.

Oil from coal–Johannesburg–South African Coal, Oil and Gas Corp. has been formed to make oil by gasification of coal. It is the first project of its kind in the Union and the government has guaranteed to finance it to an amount of $42,640,000. Initial production will be 35,000,000 gal. a year.

Urea plant for Japan–Osaka–Nissin Chemical Co. has signed a contract with Chemical Construction Corp., New York, covering engineering designs for a modern urea plant to be located at the existing plant site. One of the largest chemical producers in Japan, the Nissin Co. was formerly known as the Sumitomo Chemical Co., Ltd.

Rayon from Australian eucalypt–Melbourne–A rayon tire yarn has been spun in England from dissolved

(Continued)

DUST CONTROL

DUSTUBE closes the windows to heat loss



AND SAVES $6,000 yearly for GRAND RAPIDS STORE EQUIP. CO.

Installation of Dustube Collectors solved a heating and dust problem and saved $6,000 yearly for the Grand Rapids Store Equipment Co., Grand Rapids, Mich. Previous cyclone collectors partially removed the dust created by wood working operations . . . but also removed 70,000 cu. ft. of warm air per minute along with it. Due to the low efficiency of the units none of this air was returned to the plant so it had to be replaced from outside the building. This necessitated the use of window heaters to temper the huge quantities of cold air drawn into the plant in cold weather.

Now with the Dustubes, most of the window heaters are eliminated.

The Dustubes filter the dust laden air and clean it so efficiently it can be returned to the plant . . . with practically no heat loss. In addition the collected wood dust is fed directly to the boiler room and is used as heating fuel.

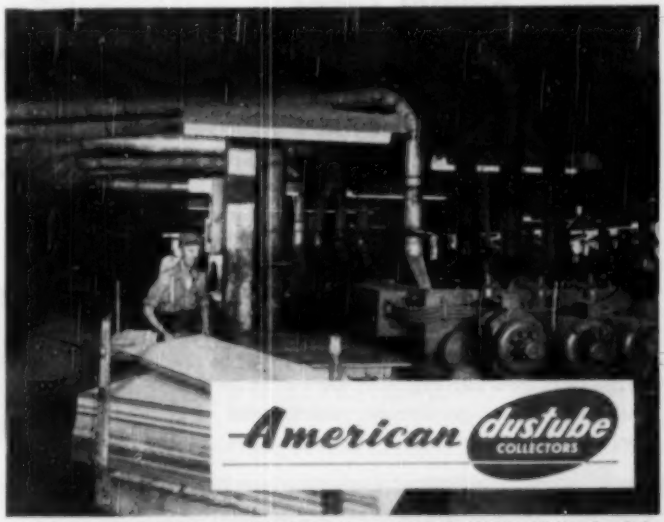
Though a cost study has not been made, Mr. C. D. Stratton, Maintenance Superintendent estimates that a saving of 35% in fuel consumption will be effected.

The Dustube brought about other savings too. Plant maintenance has been reduced as there is no longer a vacuum created inside the plant to play havoc with the building.

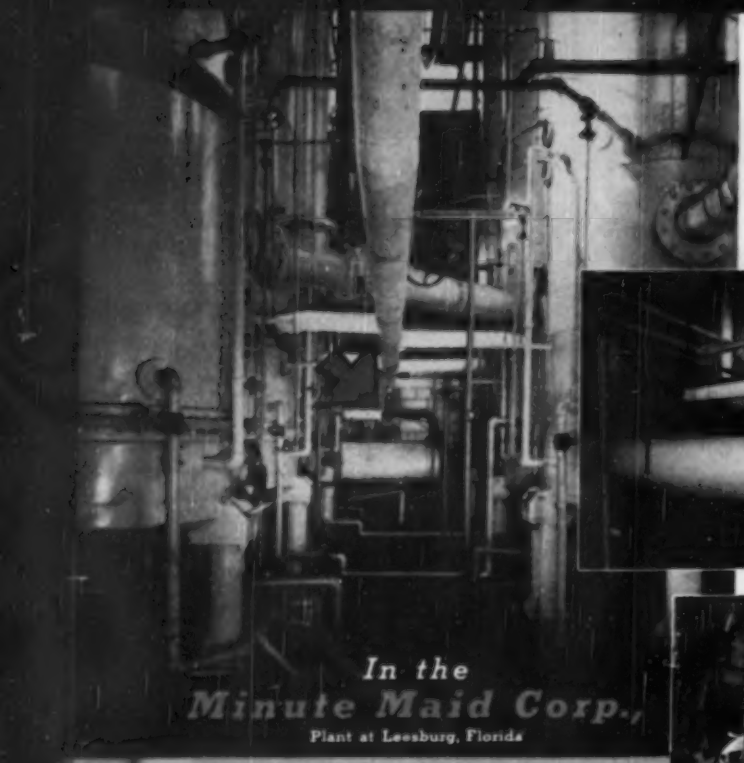
Community relations have improved and all complaints have stopped as dust is no longer exhausted into the atmosphere.

Working conditions and production efficiency have been improved due to the elimination of the dust nuisance and the rearrangement of their production machinery to provide a better flow of work.

You, too, can put your dust collection on a paying basis with a Dustube. Write today for full details.

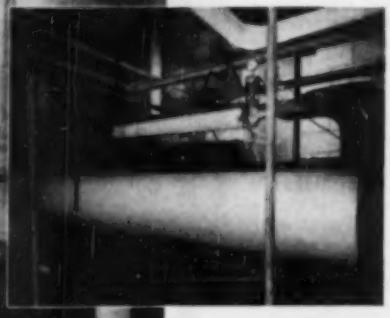


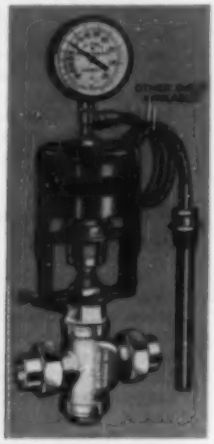
AMERICAN WHEELABRATOR & EQUIPMENT CORP., 347 S. Byrkit St., Mishawaka, Ind.

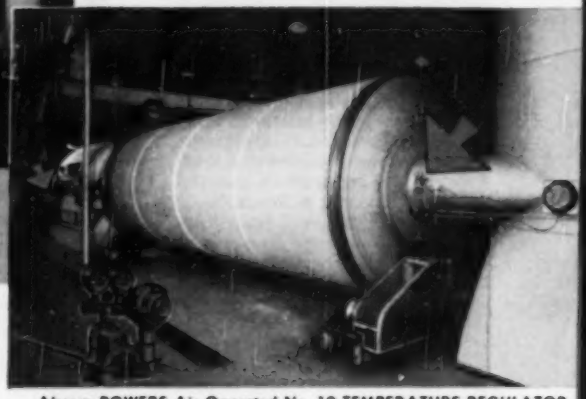


In the
Minute Maid Corp.,
Plant at Leesburg, Florida

POWERS No. 11 Self-Operating TEMPERATURE INDICATING REGULATOR. Has easy to read 4" dial correctly gives temperature of pulp and liquid being heated before entering evaporators. Regulator valve controls steam supply to large heater shown below.







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With almost 60 years of experience and a wide variety of pneumatic and self-operated regulators POWERS engineers are well qualified to help you get the most value for your money. Phone our nearest office or write—

(MMC)

Above: POWERS Air Operated No. 10 TEMPERATURE REGULATOR controlling valves on Oil Burners and Dampers of HEIL CO. ROTARY DRYER.



Below:
POWERS No. 11 Self-Operated TEMPERATURE REGULATOR automatically controlling steam supply to large double cylinder heater.



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pulps from eucalypt, the Australian hardwood. The Australian Paper Manufacturers Ltd. has cooperated on this development with the technical staff of Courtalds Ltd. and hopes to be able to meet the English rayon firm's pulp requirements by the time its projected Australian rayon tire yarn plant is completed.

Water-soluble DDT—Bombay—Bombay government chemists claim to have prepared a water-soluble form of DDT. Odorless and avialable as a paste, the new form is said to mix readily with water.

West German imports—Frankfurt—The West German Inter-Ministerial Committee has authorized import of raw materials, semi-finished and finished goods to an approximate value of $33,500,000. Imports from the United States will include: coal tar products, $200,000; industrial chemicals, $950,000; sulphate cellulose from the U. S. and Canada, $1 million.

India and Uranium—Madras—India's first factory for producing uranium and thorium, used in the production of atomic energy, from the mineral monazite will start functioning in about six months, according to Mr. K. G. Menon, chief secretary of the Travancore-Cochin States Union Government. The factory will be situated at Alwaye, on the West Coast. It is a joint venture of the Central and States Union Governments, and will cost 10 million rupees.

More Nitrogen for Greece—Athens—The Confederation of Agricultural Cooperatives has announced that the Central Committee on Reconstruction Loans has approved, in principle, the establishment of a nitrogen factory by the cooperatives. The announcement adds that the confederation has set up a committee which will draw up the conditions under which internationa participation in the study and execution of the project will be carried out.

Petroleum and Spain—Cartagena—A new petroleum refinery, opened recently, has a daily capacity of 5,000 bbl. of gasoline. This may be increased to more than 15,000 bbl. daily. The refinery is controlled by the Spanish State in collaboration with private Spanish interests and an American company.

—*End*

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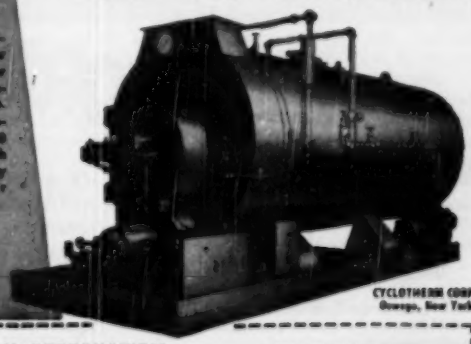
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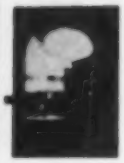
This lead pipe was exposed to Dilute HNO_3 for 2 weeks.

Pipe corroded half-way through, unsuitable for further service.



This glass-lined steel elbow was exposed to 10% HF for 1 day.

Glass lining completely removed from fitting.



This porcelain elbow was dropped 6 feet onto concrete.

Damage complete.



This plastic-lined steel elbow was heated at 250°F. for 1 day.

Short exposure to heat produced breakdown of the lining.



This high-silicon iron elbow was subjected to thermal shock.



This plastic elbow discolored ethyl acetate.

This "KARBATE" impervious graphite elbow was:



1. Exposed to 30% HNO_3 for 2 weeks
2. Dropped 6 feet onto concrete
3. Subjected to thermal shock
4. Exposed to 10% HF for 1 day
5. Heated at 250°F. for 1 day . . . and
6. Did not discolor ethyl acetate

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MANY corrosion-resistant materials are suitable for specific operations, BUT can they handle UNFORESEEN changes in operating conditions? The six materials shown above were subjected to conditions outside their range of application. They failed. But "Karbate" impervious graphite took all these conditions, and will continue to take them, not for days or weeks, but for years.

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The Corrosion Forum

MORGAN M. HOOVER, *Assistant Editor*

Construction Materials in the Paper Industry
Part II—Bleaching

This month's Corrosion Forum concludes Part II of a symposium in which materials of construction are evaluated for various services in the paper industry. Part I dealt with stock handling and appeared in the September and October issues. The first portion of Part II appeared in the October issue. Parts III and IV will deal with acid pulping and alkaline pulping respectively.

Chlorimet

WALTER A. LUCE, *The Duriron Co., Dayton, Ohio*

Chlorimet 3 shows excellent resistance to chlorine and chlorine compounds and, therefore, finds application for handling bleach solutions in the pulp and paper industry providing the temperature remains low. This alloy is resistant to moist chlorine gas and all hypochlorite bleach concentrations commonly encountered in pulp bleaching; it can be successfully applied to both bleach make-up and handling.

Chlorimet 3 is a nickel-base alloy with a nominal chemical composition of 60 percent Ni, 18 Mo, 18 Cr, 3 Fe max. and 0.07 C max. The nickel-molybdenum alloy Chlorimet 2, which has a nominal chemical composition of 63 percent Ni, 32 Mo, 3 Fe max. and 0.10 C, is severely attacked by chlorine in the presence of moisture and by unstable compounds. It is not recommended for use in bleaching operations because of their oxidizing capacity. Both alloys are available in the cast form only.

Despite the excellent resistance of Chlorimet 3 to commercial pulp bleaching conditions, it is only applied in specific services where less expensive alloys will not suffice. In addition to the comparatively high initial cost of this type alloy, the fact that it is only available in the form of pumps and valves has also restricted its use since the high-silicon iron alloys, Duriron and Durichlor, also show equivalent corrosion resistance and are much lower in cost. Its greatest application to date has been in plug valves in combination with Durichlor for handling moist chlorine gas and bleach solutions containing a high available chlorine content. The high strength of the Chlorimet 3 valve body and the high hardness of the Durichlor plug make an ideal combination for services where galling resistance and excellent corrosion resistance are desired. Chlorimet 3 pumps are also being successfully used in handling hypochlorite bleach solutions where a high strength alloy is desired.

Durimet 20

WALTER A. LUCE, *The Duriron Co., Dayton, Ohio*

Durimet 20 shows satisfactory resistance to many of the common bleach solutions used in the pulp and paper industry. For instance, experience indicates that it is capable of handling the alkaline bleach solutions, sodium and calcium hypochlorite, at ambient temperatures if the concentration does not exceed approximately 3 percent available chlorine. However, it is necessary, as with all stainless steel in the presence of chlorine or unstable chlorine compounds, to be extremely cautious in its application since these corrosives can cause severe and often unpredictable attack.

Despite the indicated good service from this alloy in pulp bleaching applications, it is not widely applied in the pulp and paper industry. Equipment made from castings, such as pumps and valves, can be purchased in the high-silicon iron alloys, Duriron and Durichlor, and the nickel-molybdenum-chromium alloy, Chlorimet 3, without restriction to the concentration being handled. This fact suggests the primary reason that the use of Durimet 20 is not more widespread. In addition, it appears that it is not greatly superior to the conventional molybdenum 18-8-S stainless steel for bleach handling of the recommended concentrations. To date it has been used primarily for agitators, bleach inlets and to a limited extent, for pumping.

Durimet 20 is a highly alloyed stainless steel with a nominal chemical composition in the cast form of 29 percent Ni, 20 Cr, 2 Mo, 3.5 Cu, 1 Si, 0.07 C max. and balance Fe.

Tantalum

LEONARD R. SCRIBNER, *Fansteel Metallurgical Corp., N. Chicago, Ill.*

At the temperatures at which they are used as bleaching agents in the paper industry, neither chlorine, sulphur dioxide, hydrogen peroxide, nor chlorine dioxide attacks tantalum; and tantalum can be used in the presence of these materials, either wet or dry, with complete safety as far as corrosion is concerned.

Because bleaching is usually done at low temperatures and concentrations, conditions are seldom severe enough to require the use of tantalum equipment.

Iron and Steel

ARTHUR E. MAY, *Moore and White Co., Philadelphia, Pa.*

ALBERT W. SPITZ, *Reiter Engineering Co., Philadelphia, Pa.*

Unprotected cast iron and carbon steel are of limited use in the bleach plant of a modern pulp mill. With suitable coating or lining, however, these materials are used extensively.

A typical plant will consist of a brown stock chest, two or more washers, a chlorinator, hypochlorite cells, pumps, piping and miscellaneous auxiliaries. The applications of cast iron and carbon steel are as follows:

Brown stock chests may be constructed entirely of iron or steel, including agitation equipment. Tile chests with cast iron agitators are commonly used.

Iron and steel are not recommended for chlorinator construction.

First-stage washers are frequently built of cast iron and carbon steel, all parts in contact with the product being rubber covered.

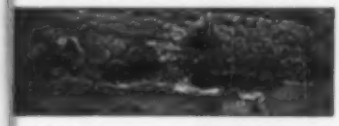
Hypochlorite towers are usually tile.

(Continued)

10-YEAR TRIAL RUN ...Tests DAMPNEY Vinyl Coating



In April, 1939, we coated this panel with one of our early vinyl formulations — forerunner of our present Dampney Vinyl Coating — and submerged it, with this second panel of unprotected steel, in room-temperature water.



Neither was removed until November, 1949, when these pictures were made. After more than ten years' continuous immersion, with the results you see on bare steel, the vinyl film remained tightly bonded and the metal beneath, sound and dry.

This is the sort of product history that assures you superlative protection from Dampney Vinyl Coating wherever service conditions demand exceptional moisture and chemical resistance.

Dampney Vinyl Coating air dries in one hour . . . the surface it adds to metal is odorless, tasteless, nontoxic and non-flammable . . . it is as effective at and above the water line as it is below.

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Rubber-covered iron and steel agitators and baffles are satisfactory.

Bleach plant pumps are usually built of more corrosion resistant materials.

Piping of lined steel is in general use. Cast iron may be used for bleach liquor lines.



Worthite pump in calcium hypochlorite bleach makeup and transfer system. Chlorine cylinder is shown at top.

Worthite

W. E. PRATT, *Worthington Pump and Machinery Corp., Harrison, N. J.*

Bleaching in the pulp and paper industry is usually accomplished with chlorine and chlorine compounds. Chrome and chrome-nickel stainless steels are of little use in these environments. The high nickel-chrome-moly alloys are more resistant and some of them have proved economical in the alkaline bleaching — calcium and sodium hypochlorites.

Worthite (Ni 24, Cr 20, Mo 3, Si 3.25, Cu 1.75) is one of these alloys that has attained a definite economical position for handling cold hypochlorite bleaching solutions as generally used in the pulp and paper industry as well as in the textile industry. To a lesser extent it is used in other industries such as oil refining. Based on long experience, the upper limits of concentration for satisfactory service from Worthite pumps has been set at 3¼ percent available chlorine for calcium hypochlorite, and 3 percent available chlorine for sodium hypochlorite. These recommendations apply up to 90 deg. F. although in a few instances good results have been reported up to 120 deg. F. In one case it was reported that Worthite was satisfactory handling NaOCl with 5 percent available chlorine, but it is not recommended for that concentration.

The picture shows a calcium hypochlorite bleach make-up system (3 percent available chlorine) installed at the American Writing Paper Corp.,

(*Continued*)

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The DURCO Type F Valve incorporates leakproof construction, full-opening round ports and a high safety factor for use over wide temperature and pressure ranges. Presently available in 150# flanged and screwed designs—¼" through 1". It operates with

NO packing
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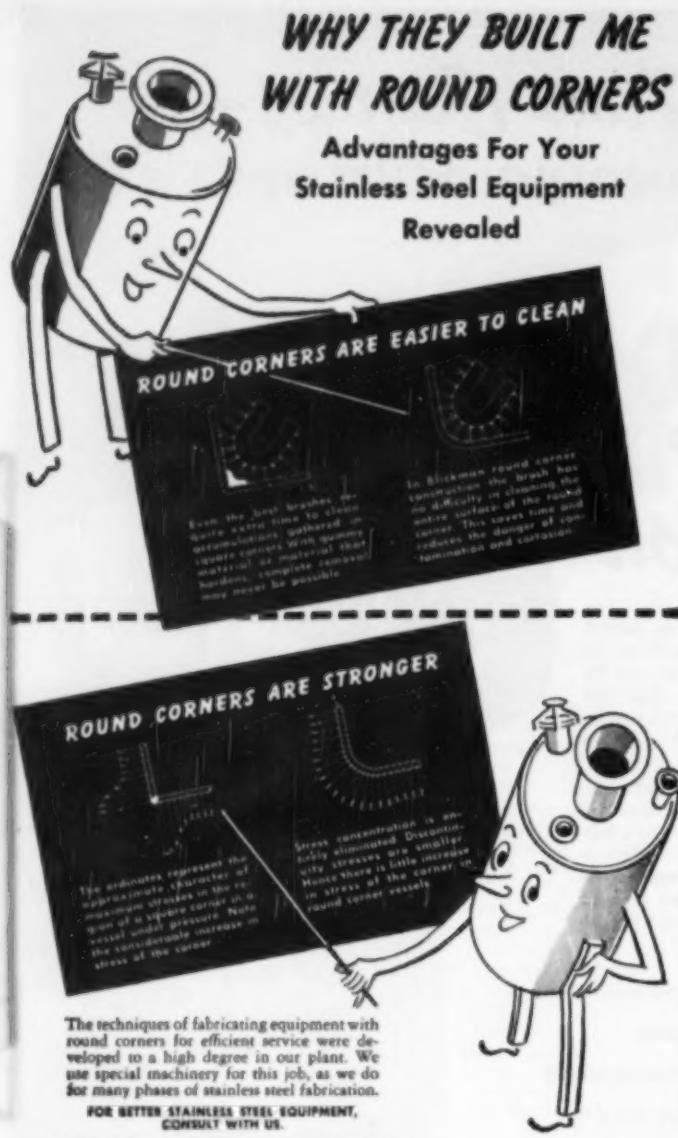
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FOR CORROSION RESISTANCE

WRITE . . .

today for Bulletin 647 giving complete information on materials of construction, corrosion resistance, construction and operating details, sizes and dimensions.

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THE DURIRON COMPANY, Inc., Box 1099, Dayton 1, Ohio



Holyoke, Mass. A 2CG-1A Worthite pump circulates and mixes milk of lime and chlorine, and delivers bleach to beaters. No repairs have been required on this pump, which was installed in 1945.

In one plant Worthite pumps are used for $CaOCl_2$ with up to 23 percent available chlorine. Repairs are required rather frequently, but the user claims the low cost and quick availability of parts makes their use more economical than the higher cost, more corrosion resistant alloys.

In making tests on Worthite specimens in the alkaline hypochlorite solutions to establish whether a pump would be suitable, it is recommended that the test duplicate as far as possible the exact conditions under which the pump would be used. Thus a test on a specimen that is suspended at a point where strong light hits it and where the specimen is not continuously submerged does not duplicate the conditions inside the pump. In fact such a test has indicated a tendency to pit whereas a Worthite pump has given many years of service.

Also, in making a corrosion test, if other metals or alloys are included in the system, the corrosion test should be so made as to determine if there will be any damaging galvanic action to one or the other of the alloys. If there is any such indication then it may be wise to insulate the pump from the system by using rubber acid hose on the suction and discharge, and rubber hose for the independent water seal line to the stuffing box. It is rarely necessary to go to absolutely complete insulation of the pump as is done in electrolytic plants to avoid stray electric current corrosion.

In multi-stage bleaching, where chlorine gas or chlorine water is used in the first stage, there is usually present both hypochlorous acid and hydrochloric acid resulting in low pH solutions. Worthite is not recommended for this stage.

For corrosive bleached stock pumps, a Worthite pump would have to be made up special and the usual pattern equipment for such pumps is not suitable. Hence, it is rarely economical to consider Worthite for stock pumps. The large volume of Worthite pumps used for hypochlorite bleach solutions is therefore in standard chemical pumps which are available from stock at reasonable prices. Many of these pumps have been in service for 10 to 12 years.

For peroxide bleaching Worthite is suitable for all known conditions. While this method of bleaching is employed principally in the textile industry, it is of interest to report that

Worthite pumps are widely used for tank car unloading and transfer pumps. The best known and most widely used system has standardized on Worthite pumps.

Coatings

KENNETH TATOR, *Kenneth Tator Associates, Coraopolis, Pa.*

Bleaching operations in the pulp and paper industry are usually carried out by treatment of the pulp by chlorine followed by caustic soda. This treatment may be replaced or followed by treatment with sodium or calcium hypochlorite. These processes are carried out at temperatures below 160 deg. F., well within the thermal limitations of the usual organic protectives. Exposure conditions are therefore highly oxidizing at all stages, acidic in case of direct chlorination and alkaline in the caustic or hypochlorite stages, with high concentrations of chloride ions throughout all operations.

The selection of suitable organics then narrows to those materials which are resistant to oxidation, ideally but not necessarily resistant to both high and low pH, and for the acid stage, impermeable to hydrogen chloride permeation. The materials meeting these specifications include high-molecular-weight vinyl copolymers, polyethylene, tetrafluorpolyethylene (Teflon), vinylidene chloride polymers (Saran), and hard rubber. To obtain best resistance against HCl permeation the vinyls and vinylidene chlorides should be effectively stabilized. Application techniques for polyethylene and Teflon are now in the process of being perfected, hence past successful use has been limited to hard rubber, and more recently have included the vinyls and Saran. The resistance of natural rubber is fortified by a impermeable rubber hydrochloride film built up on its surface by the action of hydrogen chloride. One mill reports a use to date of fourteen years with rubber lined pumps and piping in pulp bleaching service. Rubber is also in use for chlorine mixers, as coverings for bleach tower agitators, and for covering of bleach wash tanks and filters.

The problem of general industrial maintenance in bleach houses is intensified by the constantly prevalent humid, chlorine-permeated atmosphere. For protection of exteriors of equipment and structurals, and for general maintenance painting the protective coatings which display good resistance to this atmosphere and which may be successfully applied under humid conditions have proven satisfactory. These include chlori-

(*Continued*)





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Recent surveys show that 95% of the demand for stainless steel piping is in these three types:

Type 304—18% chromium, 8% nickel
Type 347—18% chromium, 8% nickel, 1% Columbium
Type 316—18% chromium, 8% nickel, 2% Molybdenum

Each exhibits inherent qualities that make it ideal for certain applications. Thus, while the group as a whole covers 95% of industry's needs, individual applications should be studied carefully to determine which grade is best for the job.

For example, a prominent soap manufacturer's requirements are 10% Type 304, to eliminate product contamination—45% Type 347, to carry low temperature organic acids—and 45% Type 316, to carry the same acids at elevated temperatures.

In the food and dairy industry, where the service is only mildly corrosive, the main reason for using stainless steel is to promote cleanliness and to eliminate contamination. Type 304 satisfies most of the demand here.

To provide the greater strength, greater safety and permanently leakproof joints of welded piping construction, Tube Turns, Inc. has developed a wide selection of types and sizes of welded fittings and flanges in all three grades of stainless steels listed above. It's the most complete line available today.



TUBE-TURN Stainless Steel Welding Fittings made of the three alloy types listed here, are available in a wide range of parts and sizes, including elbows, returns, tees, reducers, caps, lap joint stub ends, laterals and crosses. Flanges are also furnished.

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nated rubber, bitumin, and vinyl coatings. The latter, for most successful application should be of a suitable wash prime system.

Lead

KEMPTON H. ROLL, *Lead Industries Association, New York, N. Y.*

The bleaching of wood pulp (groundwood, sulphite, soda or sulphate) has for its object the production of a whiter and brighter stock. It improves the natural color of the pulp and also brightens pulps containing metallic compounds such as iron tannates. In addition, bleaching may also involve the purification of cellulose fiber by chemically removing ligneous material as well as other residues in the pulp.

Groundwood is generally bleached by applying dilute solutions of calcium or sodium bisulphite to the pulp, or by adding small quantities of zinc hydrosulphite either continuously by means of a dry feeder or batchwise or as an aqueous suspension from a closed mixing tank.

Sulphite and soda pulps have for many years been bleached almost exclusively with a solution of calcium hypochlorite. This was prepared by mixing bleaching powder with water and drawing off the clear, supernatant liquid. Within recent years this practice has given way to the use of liquid chlorine and milk-of-lime. Recent advances in the technique of bleaching make use of direct chlorination of the pulp along with hypochlorite and other chemical treatment.

The equipment now in use for carrying out the bleaching operation varies considerably. In the bleaching of all chemical pulp, lead is used to handle chlorine gas under approximately atmospheric conditions of temperature and pressure, particularly in the bleach liquor make-up tanks where a perforated lead coil in the bottom of the tank is used to get gas distribution.

Lead is recommended as a material for handling moist chlorine up to 230 deg. F.

A continuous pulp bleaching operation using sulphurous acid in two antimonial lead-lined tanks has been put into use in a West Coast mill. One tank is used for 24 hr. and then cut out while the other is used for the next 24 hr. Antimonial lead valves and pipe serve to convey the bleaching solution, a water solution of sulphur dioxide at room temperature.

First developed to procure a brighter paper from Western groundwood, zinc hydrosulphite is now a

(*Continued*)



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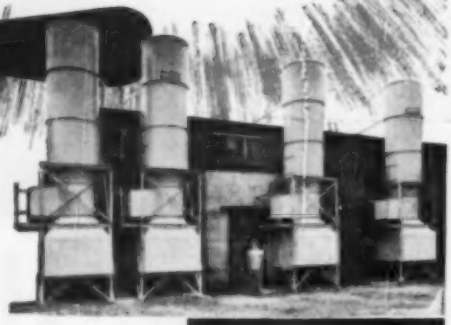
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In this plant a battery of ten 8-foot tanks are ventilated by the fume exhaust system shown. Flexibility of capacity is obtained by operation of one or more fans as production requires. Even when baskets containing the parts are lifted from the tanks, the system easily removes all steam and fumes.

Completely designed, fabricated and installed by KIRK & BLUM, this Fume Control System is another example of engineering skill and experience combined to save money for a long list of America's leading plants. For a comprehensive picture of KIRK & BLUM Fume Control Systems, write today for Booklet, "Dust Collecting Systems for Metal Industries".

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standard bleach for newsprint, specialty papers, cheap magazine and catalog papers and various boards. In kraft manufacture it is used as a brightening agent but not as a substitute for the complete bleaching process.

Chemically, zinc hydrosulphite is ZnS_2O_4; a white, anhydrous powder. A saturated solution contains 17 percent hydrosulphite. It has a powerful bleaching action, far exceeding that of sulphur dioxide or bisulphites. Bleaching action at ordinary temperatures is usually completed in less than 5 min. It is non-poisonous and only slightly corrosive on the skin but does attack most metals with the exception of lead.

Zinc hydrosulphite is manufactured from liquid sulphur dioxide and zinc dust in lead-lined tanks using cooling coils made of lead. Bleaching operations employed liquid zinc hydrosulphite use lead pipe lines for conveying the chemical to the point of use.

While the bleaching of groundwood by the zinc hydrosulphite method is not widespread, lead is excellent for handling the stock after the zinc has been added. In one process now in use, the zinc hydrosulphite powder is added to the pulp at a predetermined rate, passed through a pump to get thorough mixing, delivered to a chest or tank and allowed to stand until bleaching is completed. Because the pulp and zinc hydrosulphite mixture is acid (pH 4.5) from the presence of sulphur dioxide and other sulphur compounds, the use of lead is definitely warranted. Lead also has the important advantage at this point of not discoloring the pulp.

Recently hydrogen peroxide has been used for bleaching certain wood pulps. Lead can be used to handle this chemical at practically all normal bleaching concentrations with little or no corrosion.

Rubber

JAMES P. MCNAMEE, *U. S. Rubber Co., Providence, R. I.*

In the production of fine varieties of light colored paper, bleaching of the pulp is a necessary and very important step. Bleaching is essentially an oxidizing reaction and the most common chemical agents used to carry out the process are liquid chlorine and chlorine-bearing compounds. Since rubber compositions exhibit excellent resistance to these oxidizing agents, rubber-lined steel is an ideal material of construction for bleach plant equipment.

Hard natural rubber is extensively used for handling both dry and wet gaseous chlorine and chlorine water up to the saturation point. The dry gas has very little effect upon hard rubber, but the wet gas reacts with the surface to form a layer of rubber chloride. It develops quickly when the chlorine first contacts the rubber surface; once formed, it acts as a protective film and prevents further penetration and reaction with the rubber. The character of this reacted surface and the depth to which the reaction occurs can be controlled by specific compounding and vulcanization of the rubber lining. None of the available types of synthetic rubbers appear to have any advantages over natural rubber for this service.

An operating temperature of 180 deg. F. is usually set as the safe maximum for hard rubber although special compositions are available which may be safely used as high as 220 deg. F.

Hard rubber linings should be considered for process and storage tanks, pipe, fittings, valves, pumps, agitators, fans and duct-work. A $\frac{1}{8}$ in. thickness of lining is usually recommended, although for extreme service conditions a $\frac{1}{4}$ in. thickness will more than pay for itself in additional service life. Since linings are tailor-made for each installation, the rubber manufacturer should be supplied with all possible information on the exact service under which the lined equipment will operate so that the best type and thickness of lining can be furnished. There is no limit on the size of equipment which can be lined with rubber. Large chlorination towers 15 ft. in diameter and 60 ft. high, used in continuous bleaching systems, are regularly constructed of rubber lined steel. Continuous rotary vacuum washers for washing chlorinated pulp usually consist of a hard rubber lined vat and a hard rubber covered drum. The drum also contains hard rubber ribs which act as supports for the wire screen.

Although it is less expensive to have lining work done at the rubber factory, for equipment too large to transport or equipment that must be fabricated in place, the lining can be applied by field crews who have had extensive experience in this type of work.

In order to provide the maximum resistance to physical and thermal shock and to provide years of trouble-free operation, a hard rubber lining should contain a softer layer of rubber next to the metal. This forms a cushion between the hard, chlorine resistant outer layer and the metal surface. A construction of this type will eliminate the danger of a lining cracking during normal service.

(Continued)

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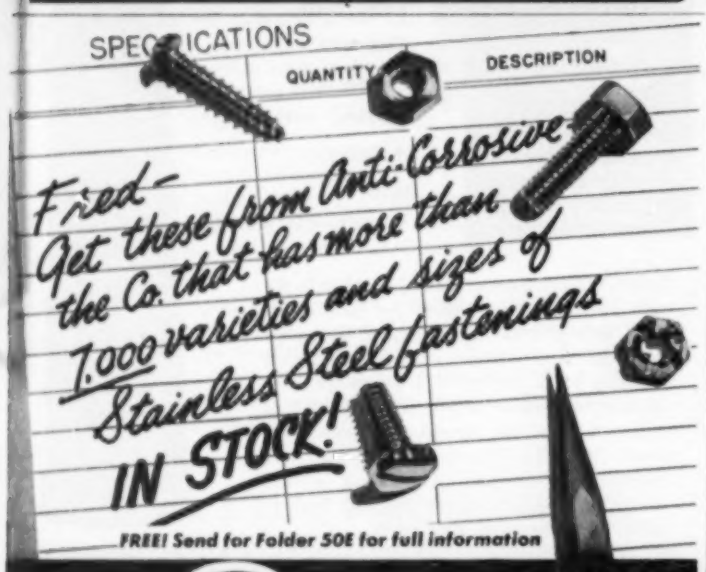
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In the majority of bleaching applications in the paper industry, abrasion is not a factor, and hard natural rubber is the best type of lining to use. If considerable abrasion is present, however, soft natural rubber should be considered. The reason for this is based on the difference in the film which forms on soft rubber as compared to the film which forms on hard rubber. Soft rubber compositions react more readily with chlorine and tend to form a thick skin which is brittle but quite strongly adhered to the unreacted rubber underneath. Hard rubbers react much more slowly and to a lesser depth than the soft rubbers; however, the chlorinated surface tends to powder off more readily. In services involving abrasion, these hard linings are sometimes subject to more rapid disintegration than soft rubber for the reason that the reacted surface is readily abraded away thus exposing more unreacted rubber which in turn chlorinates and powders off. Soft rubber is preferred in such cases, despite its greater susceptibility to chlorination because the reacted surface is firmly anchored to its parent material.

Sodium hypochlorite and calcium hypochlorite solutions are also satisfactorily handled in rubber lined equipment. This is particularly true of the tanks in which the solutions are mixed and stored. Both soft and hard compositions have been used for this purpose, although soft natural rubber of the pure-gum type appears to be less attacked by these chemicals. Many lining materials have a tendency to accelerate the decomposition of hypochlorite solutions and are, therefore, unsuitable for storage equipment. Special soft natural rubber linings are available which are unattacked by these bleach solutions, do not decompose or contaminate them and will not blister away from the metal wall —a difficulty which is quite common with ordinary soft rubber linings. This type of lining has also been used successfully in sodium peroxide bleaching operations.

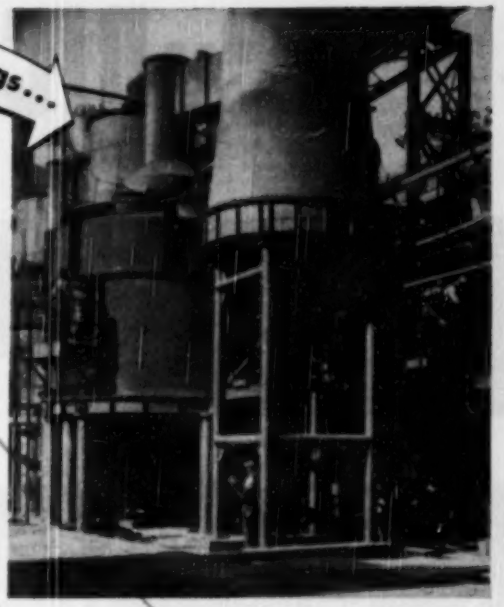
Solid plastic pipe of the Uscolite type is resistant to gaseous chlorine, chlorine water and calcium and sodium hypochlorite solutions.

NOTE: *While this article is primarily based on the author's experience, acknowledgment is made to O. R. Huggenberger, Dominion Rubber Co. Ltd., R. H. Biddle, West Virginia Pulp and Paper Co., M. G. Lyon, Champion Paper and Fibre Co., and P. B. Davidson, Strathmore Paper Co. for contributing observations based on their own operations.* —End

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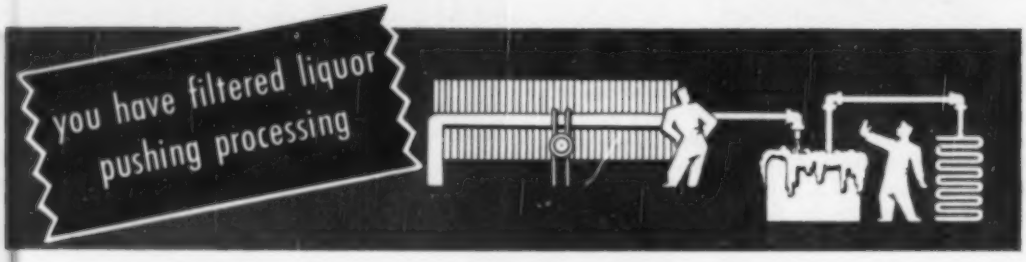
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Names in the News



MAN OF THE MONTH

Robert T. Haslam

Someone with an extra fine crystal ball must have made the decision to transform scientist, ex-college professor, Robert T. Haslam into an executive and business man. It happened about 1935 when he had been with Standard Oil Co. (New Jersey) for 17 years. Now resigning from his post as vice president and director, he can look back on both the before and after with satisfaction.

At a time when chemistry was opening new horizons for petroleum, Mr. Haslam was an expert in the field. Jersey's sales organization had come to depend so much on his technical advice in problems of marketing and service that in 1935 he was permanently transferred from Standard Oil Development to become general sales manager for Standard of New Jersey. Under his direction, such changes as larger gasoline deliveries, consolidated bulk plants and greater tank truck capacity were introduced. Per gallon costs were reduced 47 percent in his nine years as head of the sales department. Gasoline sales increased by more than 100 percent.

In 1942 Mr. Haslam was asked to organize a public relations department for the parent company of which he was elected a director. He became a vice president in 1945. Since then he has been active in rebuilding sales facilities abroad and in major reorganization of foreign sales operations.

How Mr. Haslam came to be a technical expert to begin with is the story of the years before 1935. He started out with a youthful interest in chemistry and an ambition to go to Massachusetts Institute of Technology. With the aid of summer jobs which included street car conductor and shoe salesman, he did get through M.I.T., graduating in 1911. He stayed on for a while as assistant instructor in analytical chemistry, then joined National Carbon Co., Cleveland, where he was successively research chemist, production engineer and assistant superintendent. He returned to his university as professor and head of the school of chemical engineering practice and, between 1920 and 1927, directed the research laboratory of applied chemistry, inaugurated a course in fuel and gas engineering, served as consultant to the Standard Oil Development Co., collaborated on a book called "Fuels and Their Combustion" which is still a standard college text.

His full-time career with the Jersey company began when he joined Standard Oil Development to direct work on a high-pressure hydrogenation process. As leader of a group of technicians who explored the application of this chemical process to the oil industry, he played a major role in early development of such products as 100-octane aviation gasoline, synthetic toluol for TNT, synthetic lubricants.

The earliest commercial application of hydrogenation was in the chemical improvement of lubricating oils. Mr. Haslam became increasingly involved with the marketing of these products and in 1933 was asked to reorganize the lubrication sales department of what is now Esso Standard Oil Co. As we have seen, these activities led to his highly successful shift from technical man to business man.

S. F. Coneybear and **E. C. Kenton** have been elected vice presidents of Evans Research & Development Corp., New York. Mr. Coneybear has been development manager and Mr. Kenton has been responsible for government research. Both will continue in these capacities.

B. H. Carr, head of pricing and chief statistician for Dow Chemical Co., has been named special representative in South America. A chemical engineering graduate of Clarkson College of Technology, he has been with Dow for 35 years specializing in economics.

George W. Vinal, retired chief of the National Bureau of Standards' division of electrochemistry, has been selected as the eleventh recipient of the Electrochemical Society Edward Goodrich Acheson Medal and Prize. He has been active in the establishment of the values for the international volt and ampere and is an authority on standard cells, and in primary and secondary battery fields.

William R. Johnston, formerly director of research, has been appointed vice president in charge of research for Standard Brands Inc., New York. He joined Standard Brands in 1933 as a research chemist.

Chester M. Brown has been appointed vice president, General Chemical Division, Allied Chemical & Dye Corp., New York. He has been with the company for the past 21 years. He is a graduate in chemistry of the University of Missouri.

Joseph H. Whitney has joined the laboratory and research staff of the power chemicals division of E. F. Drew & Co., New York. He has done research for Manhattan Engineering District, Du Pont and Armour Research Foundation.

Ellison H. Taylor has been named director of the chemistry division of the Oak Ridge National Laboratory. He succeeds **John A. Swartout** who has been made assistant research director.

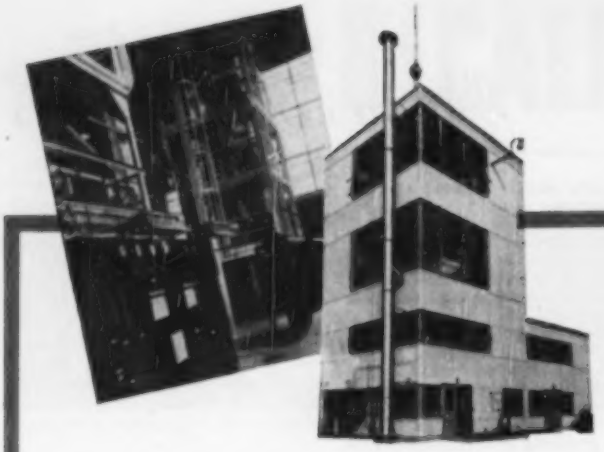
Lincoln T. Work has made arrangements with Singmaster & Breyer, New York, enabling him to offer his services as a consulting engineer. He has been associated with Columbia University as associate professor of chemical engineering, with Metal and Thermit Corp. and with Powdered Material Research Laboratories.

Robert D. Scott has been appointed director of services of Wright Chemical Corp., Chicago. A graduate chemical engineer from Kansas State College, he has been with the firm for four years.

Leroy F. Stutzman, associate professor since 1948, has been appointed chairman of the department of chemical engineering at Northwestern University's Technological Institute.

James W. Bulls, formerly chemical engineer in charge of the research group at Commercial Solvents Corp.'s Sterlington, La., plant, has been placed in charge of chemical engineering research at Terre Haute, Ind. **John J. Dorsey** has replaced Mr. Bulls at Sterlington.

(Continued)



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NAMES IN THE NEWS, cont. . .

Paul L. Enens has been appointed research engineer on the staff of the product development laboratory of Acheson Colloids Corp., Port Huron, Mich.

Peter J. Kern has joined the technical and research department of the Kinsley Chemical Co., Cleveland.



M. C. Wheeler



R. S. Egly

Maynard C. Wheeler, vice president in charge of production of Commercial Solvents Corp., New York, has been elected to the board of directors. He joined the company in 1923 as a chemical engineer, became manager of the Terre Haute plant in 1929 and later production manager for all the company's plants. He has held his present post since 1945. **Richard S. Egly** has been appointed director of chemical research in the research and development department at Terre Haute. He was formerly in charge of chemical engineering research.

Thomas E. Moffitt has been appointed assistant works manager of the Tacoma, Wash., plant of Hooker Electrochemical Co. He was formerly with Pennsylvania Salt Mfg. Co.

E. E. Hays has been made assistant general manager and director of research of the research division, Armour and Co., Chicago.

James J. Sodaro has joined McDougall-Butler Co., Buffalo, as chief chemist.

W. L. Judefind has been named assistant to the vice president of operations Davison Chemical Corp., Baltimore. **T. O. Tongue** has been made manager of process and quality control at the company's Curtis Bay plant; **P. L. Veltman** has been made manager of the research and development division there.

R. K. Mueller has been appointed assistant general manager of the plastics division of Monsanto Chemical

(*Continued*)

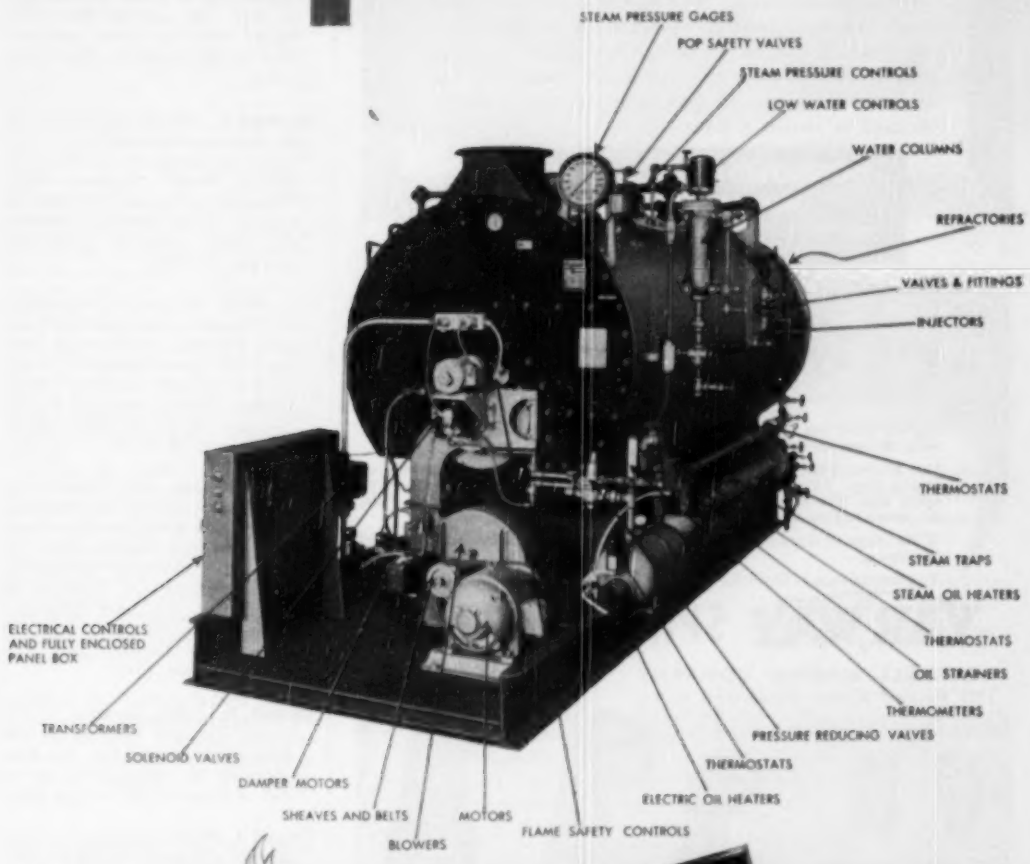
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NAMES IN THE NEWS, cont. . .

Co., Springfield, Mass. **John C. Garrels, Jr.**, succeeds Mr. Mueller as division production manager.

Eugene S. Barclay, Sharp & Dohme, Inc., Philadelphia, has been appointed assistant to the director of biological and sterile pharmaceutical production. A chemistry graduate of William and Mary, Mr. Barclay joined Sharp & Dohme in 1939 after three years with United Engineers and Construction.

William W. Brown, assistant chief engineer, Sharp & Dohme, Inc., Philadelphia, has been appointed chief design engineer. A graduate of Lehigh University in chemical engineering, he joined the company in 1940. He succeeds **Robert H. Baxter** who has been appointed head of the industrial engineering group.

Raymond L. Fitz has ben appointed production superintendent in the processing division of B. F. Goodrich Co., Akron. A graduate of the University of Dayton as a chemical engineer, he has been in the processing division since he joined the company in 1940.

L. A. Watt, director of development for Monsanto Chemical Co.'s organic chemicals division, has been appointed special assistant to the division's general manager. **A. T. Loeffler**, general manager of the company's New York branch office, will succeed Mr. Watt.

Max Luthy has been elected vice president in charge of production and research of the Givaudan Corp. and subsidiary organizations. A chemical engineering graduate of Federal Polytechnic Institute of Zurich, he was with Monsanto Chemical Co., ST. Louis, Mo., for seven years. He has been with Givaudan since 1930.

Bernard L. Lubin, formerly in the Calco Chemical Division of the American Cyanamid Co., has been added to the chemical engineering staff of Commercial Solvents Corp.

Donald S. Bolley has been appointed director of research for Baker Castor Oil Co., New York. **M. Kent Smith** has been made director of development and **Russell Hayes**, chief of the engineering department.

Chester R. Austin has been appointed manager of the development sec-

tion of the research department of Koppers Co., Pittsburgh, Pa. He has been with Koppers since 1948. Previously he had been associated with Ohio State University and then Battelle Memorial Institute in connection with ceramic research.



J. E. McKeen

John E. McKeen, president of Chas. Pfizer & Co., Brooklyn has recently returned from the British Isles where he reviewed clinical programs testing his company's newest baby, terramycin. He describes it as "the jewel of antibiotics — covers a very wide spectrum of infectious diseases."

Blue-eyed, cigar smoking McKeen, though short on years (he's 46), is long on experience with "wonder drugs," those made by Pfizer that is. He joined them in 1926 when the ink was hardly dry on his degree in chemical engineering from Polytechnic Institute of Brooklyn. He chose to work for Pfizer because of its location—Brooklyn. He was and is an enthusiastic citizen of that borough.

A $40-a-week control chemist, he added to his income by teaching in the evenings. He liked working with young people and at one time considered making teaching his life's work. Today he gives many hours to career guidance for engineering students. At a recent AIChE symposium he discussed the comprehensive orientation programs he believes management must provide to teach new executive engineering personnel the idea that good human relationships play a major role in successful business.

At Pfizer, Mr. McKeen progressed steadily. By 1935 he was a manufacturing department head. In 1936 he went to London and spent about a year assisting in the design and construction of a fermentation plant. He became assistant superintendent and superintendent in rapid succession. The company appointed him to its board of directors in 1944, the same year it put penicillin on the market. Last year he was made president.

William E. Goode, former visiting lecturer in organic chemistry at the University of Illinois, has been named instructor in chemistry at Illinois Institute of Technology, Chicago.

Leo W. Rainard has been made assistant director of research for Alexander Smith & Sons Carpet Co., Yonkers, N. Y. **Emory P. Mersereau** succeeds him as supervisor of the chemical research division.

C. W. Dunbar has been named chief engineer of Michigan Chemical Corp., St. Louis, Mich. He suc-

(Continued)



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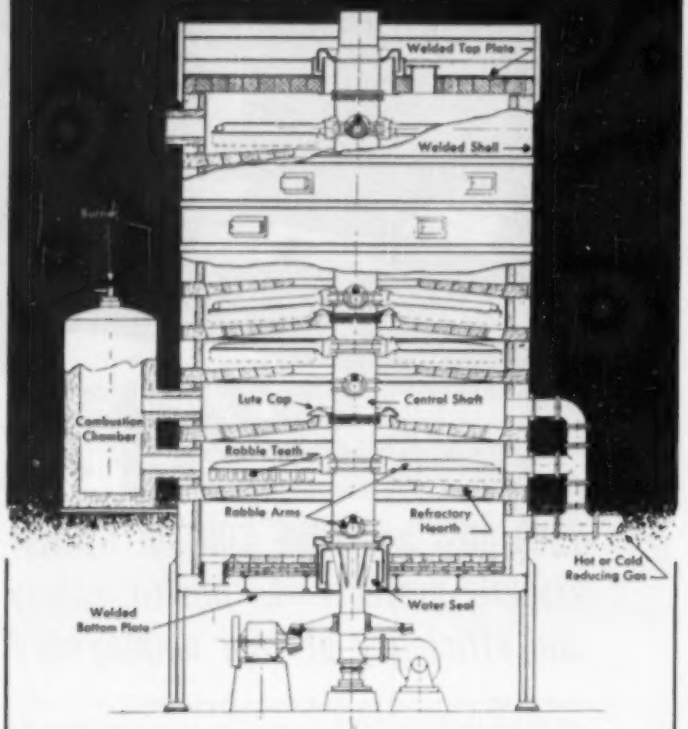
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NAMES IN THE NEWS, cont. . .

ceeds **B. J. Hunter** who has resigned to accept a position with the Union Starch Refining Co., Granite City, Ill.

H. Lee Cooper has been elected to the board of directors of Spencer Chemical Co., Kansas City, Mo.

James M. Madigan has been appointed instructor in chemical engineering at Fenn College, Cleveland.

J. Scott Brown has been appointed chief engineer for the Naugatuck chemical division, United States Rubber Co., New York. Prior to joining the company's explosives department in 1942, he was with Carbide and Carbon Chemical Corp. and Blaw-Knox Co.

H. G. Mangeldorf, formerly assistant general manager of the Esso Standard Oil Co. refinery at Baton Rouge, La., has been assigned the position of general superintendent of the Bayway refinery at Linden, N. J. **Charles Leet** formerly head of the technical division, succeeds him at Baton Rouge.

Donald Campbell has been made manager of E. I. du Pont de Nemours & Co.'s Sabine River Works at Orange, Tex. He succeeds **H. L. Wolcott** who has retired. Campbell had been manager of the company's Cellophane plant at Clinton, Iowa, since 1946.

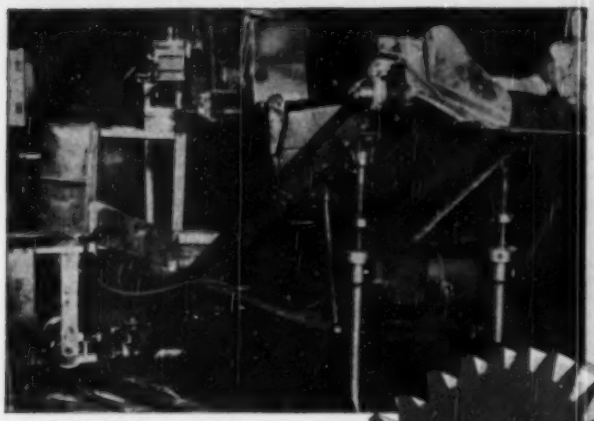
John W. Bodman, for 25 years director of research for Lever Brothers Co., has been appointed technical advisor to the management and board of directors. **Edward M. James** has been named as his assistant.

George Gabriel has been made assistant plant manager at the Mertztown plant of Atlas Mineral Products Co. He has been a plant manager there. **Robert P. Desch** has joined the company as a research chemist.

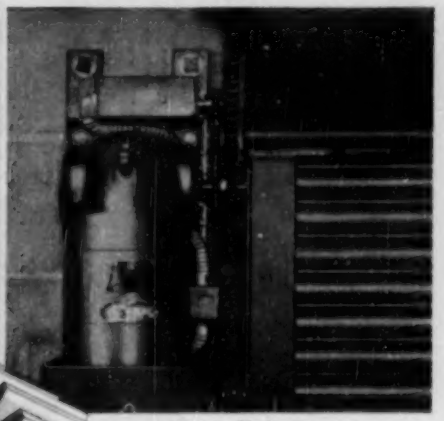
Albert T. Massberg has been appointed assistant production manager of Dow Chemical Co.'s cellulose products division. He came to the company as a chemist in 1936; was named division research director in 1946.

Alfred T. Krook has been elected president and a director of Stone &

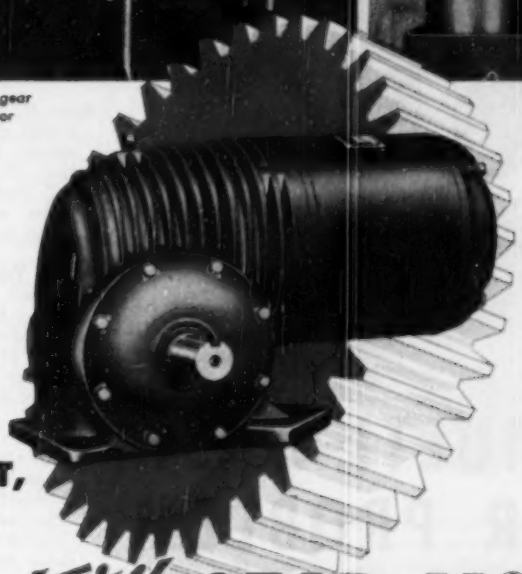
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for Your High Torque Slow Speed Requirements

Century's line of gear motors has gained an enviable reputation, created by their successful performance on thousands of industrial machines. They are built to supply the right power at the right speed.

Century Gear Motors are engineered to maintain the high torque slow speed shaft in rigid alignment. The gear housing and mounting feet are cast in one piece to provide extra strength and rigidity. In addition, the slow speed shaft is located near the base for greater strength and rigidity.

The motor is equipped with ball bearings and the shaft with tapered roller bearing.

Century Gear Motors are available in sizes from ⅛ to 1½ horsepower — single phase, polyphase and direct current.

Specify Century Gear Motors for all your slow speed power requirements.

CENTURY ELECTRIC COMPANY

1806 Pine St., St. Louis 3, Missouri

Offices and Stock Points in Principal Cities

CE-681



APPLY MULTI-WASH TO YOUR PROBLEM

ELIMINATE FUMES, ODORS AND DUST... COLLECT VALUABLE BY-PRODUCTS IN YOUR CHEMICAL PROCESSES

- VARNISH—cooking fumes
- PAINTS—pigment dusts and fumes
- FERTILIZERS—Nitrates—Phosphates
- RAYONS—Hydrogen Sulphides
- GYPSUM—kettle exhaust
- STARCH—exhaust from dryers & packaging equipment
- SUGAR—dryer exhaust and reclaim
- ALUMINA and Magnesium dusts
- TUNGSTEN and Tantalum—acid fumes and gases
- RUBBER—carbon blacks, accelerators, fillers
- GLYCERINE—fatty acids and phthalic anhydrides
- QUICKLIME—cleaning carbon dioxide gas
- PLASTICS—plastic dusts—handling and packing
- BORAX AND POTASH—exhaust from kilns and dryers

Write for information on your problem.

Claude B. Schneible Company, P. O. Box 502, Roosevelt Annex, Detroit 32, Michigan

SCHNEIBLE

NAMES IN THE NEWS, cont. . .

Webster Canada Ltd. Since 1941 he has been in charge of operations of the Stone & Webster Engineering Corp. in the southwestern United States.

J. H. Galloway has been made assistant division superintendent, west Texas division, Humble Oil & Refining Co. **John S. Bell** succeeds him as superintendent of the California district.

James O. Harris, Thomas E. Lesslie and **Maurice E. Gatens** have been added to the Nitro, W. Va., research staff of Monsanto Chemical Co., St. Louis, Mo.

Kuan H. Sun has been appointed special consultant in optical glass research for Bausch & Lomb Optical Co., Rochester, N. Y. He will study the behavior of glass under radiation, including high energy gamma rays and neutrons.

A. E. Young has been appointed assistant to the manager of the plastics division of Dow Chemical Co., Midland, Mich. He has been head of the company's coatings technical service where he is succeeded by **Norman R. Peterson.**

William S. Haldeman, head of the chemistry department of Monmouth College, has won the 1950 Midwest Award for chemical achievement sponsored by the American Chemical Society's St. Louis section.

C. W. French, for the past 15 years with Oldbury Electro-Chemical Co., New York, where he has been manager of phosphorus compounds, has joined Pfister Chemical Works, Ridgefield, N. J.

William T. Cravens has been made general superintendent of Cities Service Oil Co.'s refinery operations. He is a chemical engineering graduate of the University of Arkansas. **L. E. Taylor** has been appointed plant manager of the company's East Chicago, Ind., refinery.

Guy T. McBride, Jr., assistant professor of chemical engineering at Rice Institute, has been made associate dean for students. For several years he was with the Standard Oil Co. of California at San Francisco. He joined the Rice faculty two years ago.

R. J. Blackinton, formerly technical

director and secretary of the Western States Lacquer Corp., Los Angeles, has been appointed resin application engineer of the West Coast chemicals division of General Electric Co.

Dominic Laurie, formerly in the ceramic research laboratories of titanium alloy manufacturing division of National Lead Co., has been transferred to the ceramic production department.

Laurence H. Carr has been named director of engineering and research for Edward Valves, Inc., East Chicago, Ind. Mr. Carr has been a member of the company's technical staff since 1936, most recently as chief metallurgist.

Edgar L. Piret, professor of chemical engineering at the University of Minnesota, has received an appointment as a Fulbright Research Scholar for a year's work in France.

R. B. Worthy, vice president of Mathieson Chemical Corp., has been put in charge of the company's operations at Saltville, Va. His new responsibilities include supervision of the construction and operation of the electrolytic chlorine plant there. **Arthur T. Bennett,** vice president, has been appointed general manager of Baltimore operations.

C. C. Davis, chief chemist of the Boston Woven Hose & Rubber Co., Cambridge, Mass., has been awarded the Charles Goodyear Medal for 1950 by the American Chemical Society's division of rubber chemistry.

J. B. Scott, formerly chief process engineer and chemist for Phillips Chemical Co. at Pasadena, Tex., has been assigned additional responsibilities as manufacturing superintendent.

William H. Louviere has been elected to the board of directors of Imperial Sugar Co., Sugarland, Tex. He was made a vice president of the company last year.

R. H. Lueck has been appointed general manager of research for the American Can Co., New York. He has been with the firm for 28 years, most recently as manager of sales for the Pacific division.

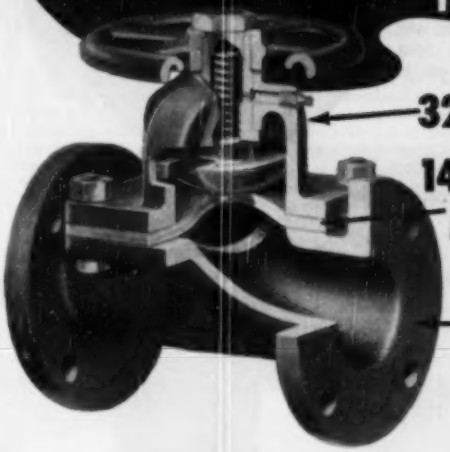
James P. Kinney, former partner in Gordon & Kinney, Inc., of Detroit, has been appointed general sales

(Continued)

Hills-McCanna offers

Over 20,000

different assemblies for valving "hard-to-handle" fluids



All the various possible combinations of bonnet assemblies, diaphragms and body materials available in Hills-McCanna valves total over 20,000! True, many of the combinations would not be practical, but this figure does indicate the tremendously wide variety of valves that Hills-McCanna offers. No matter how specialized your problem of valving corrosive and/or hazardous substances, slurries, viscous liquids, gases, fermentation products, materials subject to coagulation, foods or beverages, the chances are that Hills-McCanna can furnish the proper valve to meet your needs.

Hills-McCanna valves are Saunders patent diaphragm valves wherein the closure is affected by pressing a resilient diaphragm against a transverse weir. Working parts are isolated from the flow. The valve is leak-tight and requires no packing. Sizes from 3/8" to 14".

Write, today, for full information and descriptive literature, HILLS-McCANNA CO., 2341 W. Nelson St., Chicago 18, Ill.

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Saunders patent diaphragm valves

Proportioning Pumps

Force-Feed Lubricators • Magnesium Alloy Castings

HELICOID Chemical Gage



Standard dials: 0-15, 30, 60, 100, 150, 200, 300, 400, 500, 600, 800, 1000, 1500, 2000, 3000. Also 0-30" vac., 15 and vac., 30 and vac., 60 and vac.

Supplied with Cartridge Snubber in socket for pump service.

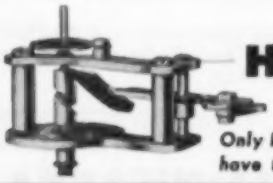
Removable bottom part and Diaphragm ring available in:

Bronze
Cast Iron
Lead Coated Iron
Steel
Stainless Steel (316)
Monel
Hastelloy B
Hastelloy C
Dural (24 S-T)
Carpenter No. 20 (Duranel)
Nickel
Everdur
Hard Rubber

● Here's a chemical gage for any pressure to 3,000 p.s.i. and also for vacuum or compound ranges, and temperatures to 300° F. Particularly suitable for chemicals and other viscous liquids that either corrode or clog a Bourdon tube gage.

One feature of this Chemical Gage is that the diaphragm is made of "TEFLON" which is flexible and resists practically all corrosive chemicals. No fragile metal foils are used. The diaphragm chamber is supplied of any metal most suitable for the service.

Available in the following dial sizes: 4½", 6", or 8½". 1" female N.P.T. bottom connection. Flanged connection also supplied.



HELICOID

Only Helicoid Pressure Gages have the Helicoid Movement

ACCO

HELICOID GAGE DIVISION
AMERICAN CHAIN & CABLE COMPANY, INC.
Bridgeport 2, Connecticut

TRADE MARK

manager in the Philadelphia division of Yale & Towne Mfg. Co. **Bruno A. Moski**, has been appointed chief industrial engineer.

Kenneth G. Lundie has been elected vice president in charge of sales and **Perry Brown**, vice president in charge of engineering, for Johnston Pump Co., Los Angeles.

Raymond D. Whitcomb has been appointed by Sprout, Waldron & Co., Muncy, Pa., as sales representative for the process industries in northern Illinois and southern Wisconsin.

Charles P. Walker, Jr., director and general sales manager of Chas. Pfizer & Co., Brooklyn, N. Y., has been elected chairman of the Drug, Chemical and Allied Trades Section of the New York Board of Trade.

Franklin T. Peters has been appointed manager of the newly-established market development department, Heyden Chemical Corp., New York. **Arthur L. Davis** has been put in charge of new products applications.

Graham W. Corddry has been elected vice president in charge of sales of Titanium Pigment Corp., subsidiary of National Lead Co., New York. **K. W. Ericson**, formerly western sales manager, succeeds Mr. Corddry as general sales manager. **James MacGuffie** has been appointed manager of the technical service department.

W. J. Kramer has been appointed vice president in charge of sales of the Lotte Chemical Co., Paterson, N. J. He has been vice president and general manager of Philipp Brothers Chemicals, Inc.

Gordon A. Jacobs has been appointed representative in charge of the Dallas division for the Detrex Corp., Detroit.

Jack A. Marshall has been appointed by Minneapolis-Honeywell Regulator Co. as commercial division sales manager for the Southeast with offices in Atlanta, Ga.

William F. Winemiller has been named chief sales engineer for the refractories division of the Norton Co., Worcester, Mass. Formerly he was refractories engineer in the Detroit area.

Albert E. Clement has been appointed

assistant superintendent of the Natrona plant of the Pennsylvania Salt Mfg. Co., Philadelphia. **Robert Clarke,** formerly assistant production supervisor, succeeds Mr. Clement as production supervisor.

Felix N. Williams, vice president and general manager of Monstanto Chemical Co.'s plastics division, has been appointed coordinator of sales for the company with headquarters in St. Louis. **William M. Russell,** general branch manager of Monsanto Chemica Co.'s Chicago office, has been appointed general branch manager of the company's New York sales office. **Forrest M. Luckett** succeeds him in Chicago.

E. M. Maxwell and **D. G. Rogers** have been appointed president and executive vice president respectively of the National Aniline Division of Allied Chemical & Dye Corp., New York.



E. M. Maxwell



L. H. Allen

Lyman H. Allen, Jr., formerly assistant chief design engineer in charge of chemical process design with the American Viscose Corp., Philadelphia, has been appointed chief engineer of Foster D. Snell, Inc., New York.

Maurice MacDonald has been appointed vice president and manager of engineering for the Hammel-Dahl Co., Providence, R. I. He has been chief engineer in charge of instrumentation and control for M. W. Kellogg Co.

Albert R. Tucker has been appointed manager of the Cleveland district sales office of the electrochemicals department of E. I. du Pont de Nemours & Co. He succeeds **Carl Dittmar** who has retired.

John V. Jirasek has been appointed manager of sales activities in the petrochemical industries for Worthington Pump and Machinery Corp., Harrison, N. J. He has been with the company since 1940.

Lawrence K. Cecil, formerly South

(Continued)

What's your tank problem?

Take our word for it, there's a Stainless Steel SAN-I-TANK — standard or special, big or little — that will solve your tank problem. Here are two standard tanks, for example, that show what we mean:



Type "CJ" is an open top, jacketed, stainless steel tank that can be used for every kind of hot or cold processing. Jacket is warranted to 150 p.s.i. working pressure. Tank can be equipped with side, bottom or top-entering agitators and all types of fittings and connections. Capacities: 60 to 1000 gallons. Write today for Bulletin JS-50.

Type "H" is a horizontal SAN-I-TANK designed to handle large quantities of liquids in minimum overhead space. This is a stainless steel, single-shell. For mixing, blending or storage purposes, it may be equipped with top or end-entering agitator and any type of connections. Available in capacities ranging from 200 to 4500 gallons. Write today for Bulletin SS-50, describing this and other single shell tanks in detail.



STAINLESS STEEL SAN-I-TANKS

METAL GLASS PRODUCTS COMPANY

BELDING 5, MICHIGAN

New York Chicago Atlanta San Francisco Los Angeles Seattle New Orleans



OIL — in drums, cans, cartons — moves continuously, without effort or attention, from packers to storage to shipping platform on Standard roller conveyors.

Many nationally known oil companies and processing plants look to Standard for their conveyor requirements — engineered power and gravity systems, portable units, special equipment.



Write, telling us what you make or handle. We will send literature showing Standard Conveyors in use in your business. Address Dept. CM-110.

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Engineered Conveyor Systems — Portable Conveyor Units — Spiral Chutes — Pneumatic Tube Systems.



Lick Corrosion Problems with
PLASTIC PIPE and TUBING

Handle any cold solution up to 120° F. with "Tru-Size" Plastic Pipe that is alkali and acid resistant.

Lighter weight, easier handling, lower installation costs. Four materials: Polyethylene, Styrene Copolymer, Butyrate and Vinyl.

Rigid or flexible in any size, ½" to 6" O. D., in any wall thickness. Close tolerances and absolute uniformity. Also fittings.

Give us your problem. We've solved lots of "toughies."

YARDLEY PLASTICS CO.
142 Parsons Ave. ADams 9315
Columbus 15, Ohio

Simple As A·B·C

It is the simplest engineering axiom that . . . the fewer the parts the less the friction and wear . . . the longer the life. The Viking Rotary Pump has "Just Two Moving Parts" . . . the simplest possible design for a pump. Little wonder they require so little power . . . need so few repairs . . . and last so long. Little wonder, too . . . why they are chosen so universally for handling chemicals and processing liquids. Write for Special free Bulletin 50SC today. No obligation, of course.


Fig. 124

See Our CATALOG IN SWEETS

VIKING PUMP CO.
CEDAR FALLS, IOWA

NAMES IN THE NEWS, *cont.* . . .

west manager for Infilco, Inc., has been made sales manager for the company.

Henry A. Rome has been appointed manager of special products sales and **William C. Hall**, manager of molded goods sales, for United States Rubber Co., New York.

James H. Batte has been named executive officer of the Technical Command Army Chemical Center, Md.

W. B. Logan, assistant manager of operations of the refining department of the Texas Co., has been made manager. He will be located in New York. A chemical engineering graduate of the University of Texas, he came to the Port Arthur Works of the Texas Co. in 1922.

F. B. Havens, formerly technical field service representative, pigment department, American Cyanamid Co., Calco Chemical Division, has been appointed Pacific Coast regional manager.

Thomas H. Fitzgerald has been appointed sales manager of reclaimed rubber for Naugatuck chemical division, United States Rubber Co., New York. He joined the company in 1923 as a chemist. **Richard K. Opper** has been appointed assistant sales manager for rubber chemicals. **Howard G. Ling**, formerly technical representative in New York, replaces Mr. Opper as representative in the Chicago district. **David E. Welch** replaces Mr. Ling.

R. G. Kress has been appointed sales manager of the newly formed polyethylene division of Extruders, Inc., Culver City, Calif.

OBITUARIES

John Johnston, 69, who until his retirement in 1946 was director of research for United States Steel Corp., died in Bar Harbor, Me., September 12.

Harry B. Weiser, 63, professor of chemistry and dean emeritus of Rice Institute, died September 27.

Arthur W. Dawes, 71, chemist at the Rensselaer, N. Y., plant of General Aniline & Film Corp., died at his home October 10. He had been associated with the plant for over 50 years.

no need to look further for **synthetic detergents**

SUPERIOR SYNTHETIC DETERGENT MATERIALS ARE AVAILABLE FROM ORONITE IN THESE THREE FORMS:

1. **DETERGENT ALKANE** For detergent or chemical manufacturers who have suitable sulfonating and processing equipment. Oronite Alkane is unique in type, quality and economy. A water-white, wholly synthetic alkyl aryl hydrocarbon, it is eminently suitable for making detergents and wetting agents of the highest quality.

2. **DETERGENT SLURRY** For detergent processors and manufacturers with blending and drying equipment. Detergent Slurry is an alkyl aryl sulfonate in paste form, easily blended for producing quality detergents.

3. **DRY DETERGENTS** Alkyl aryl sulfonates in dry form. New whiter color—available in 3 particle sizes, readily adaptable to compounding and repackaging operations.

Detergents from Oronite Alkane, in addition to providing unexcelled cleaning action are: superior emulsifiers of fats and greases; stable and effective in strong acid and alkali solutions; effective as reducers of surface and interfacial tension even in low concentrations. For complete detailed information, write the Oronite office nearest you.

OTHER ORONITE PRODUCTS:

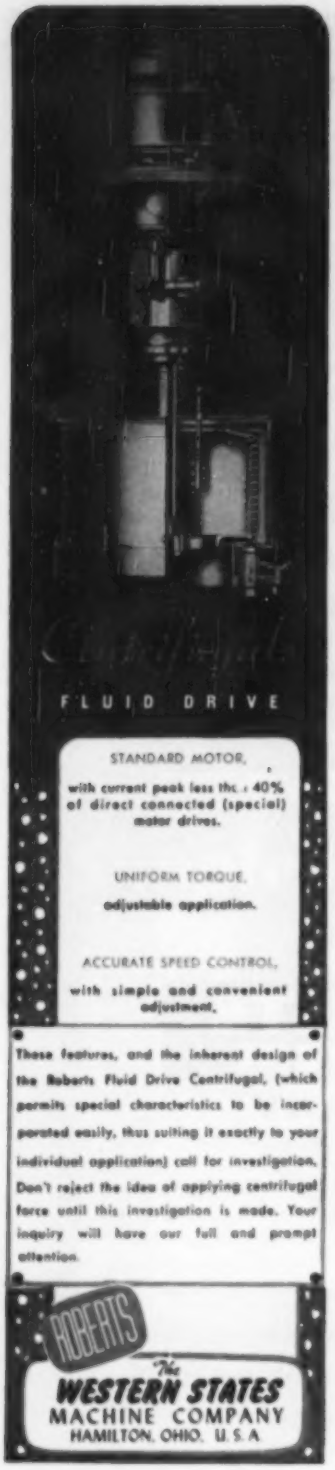
Polybutenes • Cresylic Acids
Naphthenic Acids
Sodium Sulfonates
Purified Sulfonate
Phthalic Anhydride
Gas Odorants
Wetting Agents
Ortho, Para Xylene
Xylol
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ORONITE CHEMICAL COMPANY

THE NAME TO WATCH IN CHEMICALS

ORONITE CHEMICAL COMPANY

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STANDARD OIL BLDG., LOS ANGELES 15, CALIF.
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200 S. MICHIGAN AVENUE, CHICAGO 4, ILL.
925 WHITNEY BUILDING, NEW ORLEANS 12, LA.



INDUSTRIAL NOTES

NEW FACILITIES

Nopco Chemical Co., Harrison, N. J.—Two plants in Richmond, Calif., to be utilized in its Pacific division's expansion program in the manufacture of industrial chemicals. The company's four-year old plant at 1141 South 14th St. is being converted to the manufacture of stearates and palmitates by Metasap Chemical Co., a wholly owned subsidiary. Production is scheduled to begin next January. The other plant, at 1140 South 10th St., is being fitted for production of chemical processing specialties and agricultural products. Formerly devoted to vitamin oil processing, it should begin turning out its new products before the end of the second quarter, 1951.

Chase Bag Co.—A pulp storage warehouse at Chagrin Falls, Ohio, which will be ready for occupancy early in 1951. Contract for design and construction has been awarded to H. K. Ferguson Co., New York.

Eclipse Fuel Engineering Co., Rockford, Ill.—A main factory and office building scheduled for completion within a few months. It will increase manufacturing area over present quarters by 20 percent.

Armstrong Cork Co., Lancaster, Pa.—Research laboratories for which the cornerstone was laid last month. Scheduled for completion by mid 1951, they will cover 162,000 sq. ft. of floor space and will be located on a 40-acre site four miles west of Lancaster.

General American Transportation Corp., Chicago—A plate and welding division office in Tulsa, Okla. —J. D. Camp heads the office and will handle sales of the company's fabricated equipment.

Minnesota Mining & Mfg. Co., St. Paul—A $250,000 branch warehouse and office building in Cleveland. It will contain 30,000 sq. ft. of floor space; is scheduled for completion January 1.

Ohio Injector Co., Wadsworth, Ohio —Reorganized sales services. Five major sales divisions have been established. They are: New York division headed by D. J. Mooney Jr., New York; Atlantic division headed by Paul E. Warner, Philadelphia; Central division headed by E. G. Shepard, Wadsworth, Ohio; Mid-Continent division headed by A. A. Kruse Jr., Dallas; Pacific division headed by D. Gordon, San Francisco.

Standard Oil Co. of Ohio, Lima—A two-story office and laboratory building recently completed for them by the H. K. Ferguson Co., New York.

Spencer Chemical Co., Kansas City, Mo.—A southeastern district sales office in Atlanta, Ga., with John L. Sanders as manager.

Sharp & Dohme, Inc., Philadelphia—High vacuum drying equipment for its new blood plasma processing plant, to be designed, fabricated and installed by National Research Corp., Cambridge, Mass.

Morningstar, Nicol, Inc., New York—A sales and technical service office in Charlotte, N. C.

Canadian Industries Ltd.—A $3 million explosives plant near Ogden outside of Calgary in Alberta.

Quaker Chemical Products Corp., Conshohocken, Pa.—Boilers and a boiler house which will provide three times present capacity when they are completed early in 1951.

Sharp & Dohme Inc., Philadelphia—A branch office and warehouse in northeast Baltimore. W. L. O'Neill is branch manager. The company's Argentine branch has opened a larger branch office in Buenos Aires

Atlas Chain and Mfg. Co., Philadelphia—A branch office and warehouse in Chicago.

Reliance Electric & Engineering Co., Cleveland—Canadian manufacturing facilities through purchase of Commonwealth Electric Co., Ltd., Welland, Ontario.

General Electric Co., Pittsfield, Mass. —A sales office in Washington, D. C., for its chemical department.

Minneapolis-Honeywell Regulator Co. —An independent field sales organization for its valve division. The nucleus of the new organization will consist of regional sales managers

(Continued)

MAXIMUM STEAM EFFICIENCY

Valuable waste heat recovered and put to work by Cochrane C-B System . . . new developments in better steam usage increase process production by maintaining high and uniform temperatures at equipment.

THE COCHRANE C-B SYSTEM— WHAT IT IS

The Cochrane C-B System is actually two pumps in one. A specially designed centrifugal pump energizes an eductor. It pumps the condensate from drainage return lines into the boiler against boiler pressure, in a closed circuit, at any temperature or pressure—with complete, automatic elimination of entrained air from the circuit before discharging the condensate into the boiler.

The C-B System speeds up the flow of condensate and eliminates the entrained air with the condensate from the process equipment. This results in a higher temperature on the heating surface from a given initial steam pressure—increasing the heating efficiency often as much as 20%, increasing production as high as 61% and effecting fuel savings from 10 to 25%.

WHAT FASTER AND MORE UNIFORM HEATING IS DOING FOR THE PROCESS INDUSTRY

The following excerpts were taken from enthusiastic letters of Cochrane C-B users:

"Our cooking time has been reduced 50%."

"We saved $6000 a year on steam recovered."

"We increased the capacity of our 6 Revolving Drum Dryers 63%."

"Felt is now dried 40% faster with the C-B System and we save 25% on fuel."

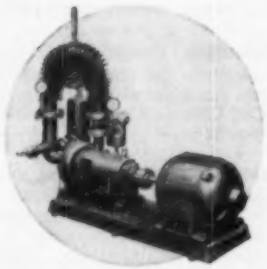
"Uniform heat has increased our production of plasterboard to 10,000 square feet per hour in addition to saving $5600 a year on fuel."

"Our drying time has been reduced 20%."

"Capacity of our jacketed kettles has been increased 50%."

"Our output of double wall board was increased 61%."

"We doubled our plant capacity without adding any additional equipment."



For full details of the C-B System write for a copy of Publication No. 3250.

COCHRANE CORPORATION
3113 N. 17th Street Philadelphia 32, Pa.

COCHRANE C-B SYSTEM

CONDENSATE RETURNED TO BOILERS AT HIGH PRESSURE AND HIGH TEMPERATURE



Where Water Works PENFIELD PAYS!

Yes, wherever water has work to do as a raw material, Penfield Ion Exchange Systems are contributing improved end-product results as well as important savings in water purifying costs.

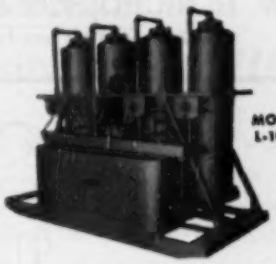
Whether your requirements for dependable, uniform quality, high purity water are 5 gallons per hour or 1,000, there is a Penfield "package" Demineralizer waiting to pay off for you.



MODEL UL-200

Cut water purifying costs from 10% to 98% . . . In comparison with distilled water costs, Penfield Ion Exchange Systems (200 gals./hour Model is illustrated at left) often provide savings as high as 85% and in one reported instance cut costs 98%. The national average chemical cost of the Penfield process is 1.5c per 1,000 gallons (one hour's production). In low solid areas, the chemical costs run as little as 3c per 1,000 gallons of treated water.

Produce solids-free water of exceptionally high purity . . . Penfield industrial de-ionizing units such as the 1000 gals./hour model illustrated at right, transform raw water into uniform quality water containing zero to two parts per million of ionizable salts and a pH of 6.5 to 7.5 — under the proper conditions, even remove CO_2 and SiO_2. Electric conductivity meters provide continuous indication of purity, warning when resins need simple regeneration.



MODEL L-1000



MODEL U-60

Self-contained units, requiring no heat or steam power for operation . . . Penfield Demineralizers are compact, completely assembled in stainless steel cabinets, "package" units — needing only connection to raw water source, drain and electrical outlets. Units such as the 60 gals./hour model illustrated at left, even may be used as "portable packages." In all cases, Penfield Demineralizers are ready for immediate operation upon arrival at site. No preliminary "boil-out," heat or steam power is ever required.

Write today for "Penfield Pays" folio — includes specification sheets for all Penfield Ion Exchange units, pertinent information about Penfield demineralized water, and handy chart for figuring savings Penfield can contribute under your operating conditions.



PENFIELD
MANUFACTURING CO., INC.
19 High School Avenue, Meriden, Connecticut

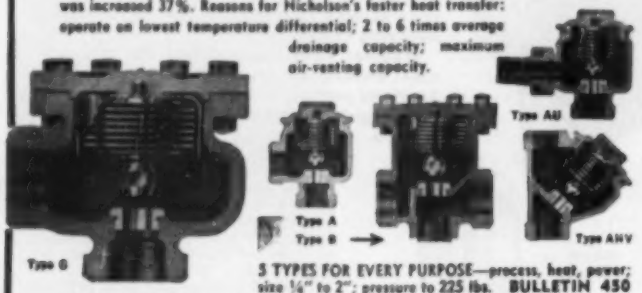
Mfg. A'gts! Write for selected territories still available.

Well-Known Processor

Puts 37% More Thru Cookers

With Nicholson Steam Traps

A leading drug manufacturer found that a recent Nicholson thermostatic steam trap installation, replacing a mechanical type, so cut kettle time that their production was increased 37%. Reasons for Nicholson's faster heat transfer: operate on lowest temperature differential; 2 to 6 times average drainage capacity; maximum air-venting capacity.



5 TYPES FOR EVERY PURPOSE—process, heat, power; size ¼" to 2"; pressure to 225 lbs. BULLETIN 450

HIGH-PRESSURE FLOATS—Stainless, monel, steel or plated steel. Welded. In all sizes and shapes; for operating mechanisms and as tanks or vessels. 2-day delivery. BULLETIN 650



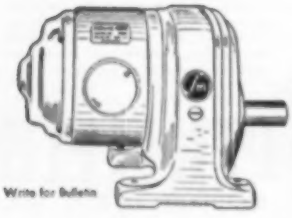
W. H. NICHOLSON & CO.

206 Oregon St., Wilkes-Barre, Pa.



The Key to production problems

Open the door to greater production with Sterling Slo-Speed electric power drives.



Write for Bulletin

STERLING ELECTRIC MOTORS

Plants: New York • Los Angeles • Hamilton, Canada
Offices in Principal Cities

SLO-SPEED (Geared) • SPEED-TROL (Variable Speed) • KLOSD (Normal Speed)

INDUSTRIAL NOTES, cont. . .

and staff of upwards of 20. It will provide national coverage.

Monsanto Chemical Co., St. Louis—District offices in Cleveland and Cincinnati headed by T. C. Tupper and J. C. Hutchison, respectively.

Stone Container Corp., Chicago—A paper mill in Mobile, Ala., through its purchase of the plant of the Mobile Paper Mill Co.

Atlantic Research Corp., Alexandria, Va.—An organic synthesis group to synthesize compounds not generally available through commercial supply houses.

NEW NAMES

Carter Products Corp., Cleveland, has changed its name to Carlon Products Corp. The company has recently started production of extruded plastic products at a new plant in Corsicana, Tex.

Paraffine Cos., San Francisco, has changed its name to Pabco Products Inc. to identify the company with its products which have long been sold under the trade name, Pabco.

R. J. Prentiss & Co., New York, manufacturer and distributor of chemicals, botanicals, insecticides and rodenticides, has changed its corporate name to Prentiss Drug & Chemical Co.

NEW REPRESENTATIVES

Tyson Corp., manufacturer of rubber substitutes and vulcanized vegetable oils, has appointed Kraft Chemical Co., Chicago, as its exclusive Midwest agent.

Sier-Bath Gear and Pump Co., North Bergen, N. J., has appointed the following companies as representatives for its gear coupling: J. R. Ruddock & Associates, Chicago; Volco Co., Minneapolis; W. B. Conrad Co., Detroit.

De Laval Steam Turbine Co., Trenton, N. J., has appointed R. M. Sorlie Co., Kalamazoo, Mich., as sales representatives for its full line of pumps, worm and herringbone gear speed reducers, and couplings.

W. W. Sly Mfg. Co., Cleveland, has appointed the Horrell Co., Los Angeles, to act as sales engineers for its line of industrial dust control and sandblast equipment.

Chaffee Design and Mfg. Co., East Aurora, N. Y., designers and builders of special production and packaging machinery, has appointed Hardy, Hember & Co. as its representatives in the Chicago area.

Howell Electric Motors Co., Howell, Mich. has appointed Bates Sales Co., St. Louis, Mo., as factory sales and service representatives.

Barry Corp., Cambridge, Mass., has appointed the Campion Sales Co., Dallas, Tex., as its southwestern representative.

Affiliated Gas Equipment, Inc., Cleveland, has appointed Gale Engineering Co., New York, as industrial division representatives to handle sales in the Metropolitan area.

Reliance Electric Engineering Co., Cleveland, has appointed Boyd Engineering Co. its sales representatives in Arizona, New Mexico and the western part of Texas.

Sterling Drug Inc. has appointed Vilar Brothers y Mejia, Mexico City, as agent for sales of dyestuffs and intermediates to the Mexican textile industry for its Hilton-Davis Chemical Co. division.

NEW LOCATIONS

Graham, Crowley & Associates, consulting electrochemists and engineers, has moved its general offices and Chicago research laboratories to 341 East Ohio St., Chicago.

Phillips Rotary Joint & Valve Co. has moved its factory and offices to 5711-5613 Boulevard East, West New York, N. J.

Fitzsche Brothers, Inc., New York, has moved its San Francisco office to 681 Market St.

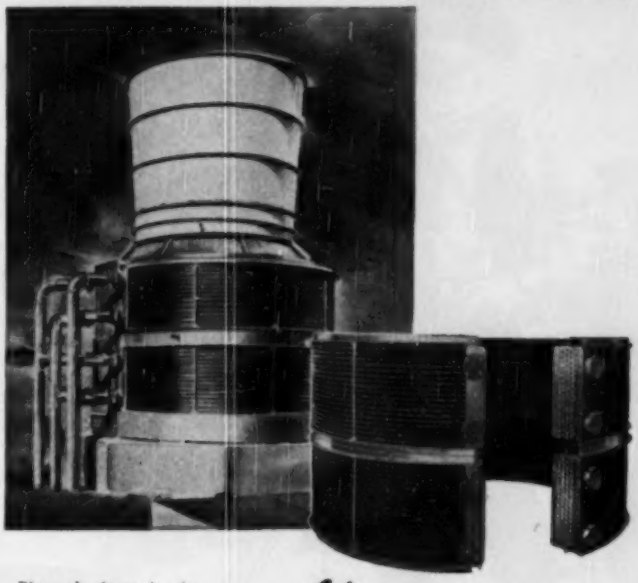
NEW COMPANIES

Stone & Webster Canada Ltd., Toronto, a subsidiary of Stone & Webster Inc. Alfred T. Krook has been named president. Headquarters are in Toronto.

Adams-Henry Chemical Co., New York, to act as selling agents and distributors of industrial and fine chemicals, intermediates and dyestuffs.

Textor Laboratories, Cleveland, to specialize in analytical work, sampling, research, physical testing and inspection. —End

for Efficient HEAT EXCHANGE

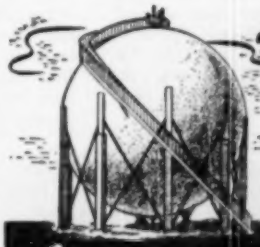


Pictured above is the new Type "E" QUINT-AIR *Air Cooled Heat Exchanger*, designed, engineered and manufactured by J. F. Pritchard & Co.'s Equipment Division. Curved Aerofin sections (*see illustration at right*) enable this unit to take maximum advantage of winds from any direction. Especially suited for engine and compressor jacket water cooling.

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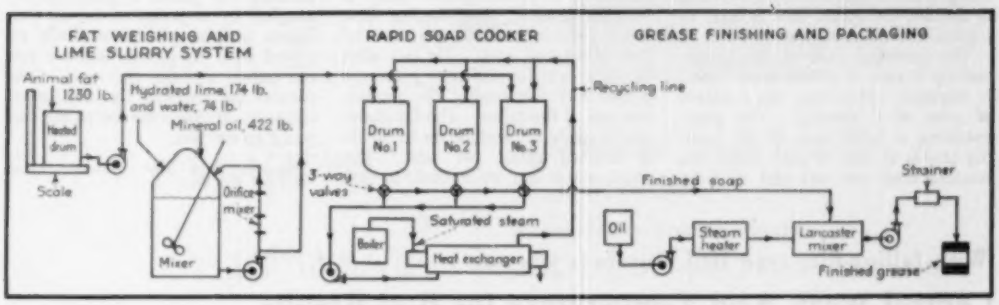
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Quotes, Extracts and Digests

MORGAN M. HOOVER, Assistant Editor



New Process Makes Grease Continuously

NOTE: While basic grease compositions haven't changed to any extent, the method of making them has departed from the traditional batch method for the first time in the 90 yr. history of grease-making. The Esso Standard Oil Co. is now operating a continuous grease-making plant at its Baltimore refinery.

Because lime-base greases constitute the largest group in use, the process is devoted to production of this type. The other greases such as soda-base, cold-sett, and lithium-soap are still made by the batch process. In less than 1 hr., the continuous grease plant can produce as much as the largest batch kettle can make in almost 4 hr.

The continuous grease plant may be divided into three sections. One section receives fat pumped from a field storage tank, weighs the fat in a heated drum and pumps it to the soap-cooker section. Also in the first section is a lime-slurry system from which a mixture of hydrated lime-slurry is pumped into one of three soap-cooking pressure drums, and then circulated through a heat exchanger to saponify them, and back into the drum. Circulation continues for a sufficiently long period to produce finished soap. The drum is then emptied and its contents pumped to the grease section. Meanwhile the two remaining soap-cooking drums are either being charged or placed on stream.

Finished soap enters a mixer where it meets lubricating oil. Proper mixing under controlled conditions produces lime-soap grease at the required speed. The grease is pumped through a strainer directly to a packaging area.

FAT WEIGHING AND LIME SLURRY SYSTEM

A typical formulation for grease-base to charge a rapid soap-cooker consists of approximately 1,230 lb. of fat, 174 lb. of hydrated lime, 74 lb. of water and 422 lb. of low-viscosity, pale lubricating oil. The liquefied fat is weighed and pumped to one drum of the rapid soap cooker shown in the flow chart. The hydrated lime is weighed, slurried with lubricating oil with the aid of a rotary impeller and orifice mixer, and then charged to the pressure drum containing the lime.

RAPID SOAP COOKER

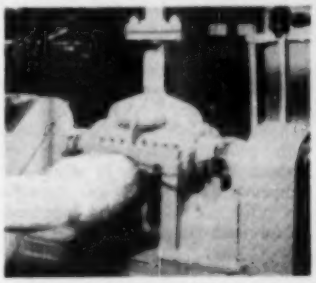
The soap cooker is called rapid because it produces almost immediate saponification of lime and fat, and about 93 percent of the charge saponifies in 25 min. whereas in regular grease kettles saponification may require 4 hr. Within 1 hr. the mass in the rapid soap cooker is finished soap. The flow chart shows that during this time the soap-cooker charge is circulated from a drum through a heat exchanger, then back to the drum. As the soap mixture is circulated, its temperature rises to about 330 deg. F. in 20 min. Pressure during this period is about 80 psi. The temperature does not rise much above 330 deg. F. during the remainder of the soap-making cycle. Before soap is released from a drum, a sample is taken and analyzed for free lime content. The soap must contain less than 0.2 percent free lime before the drum is cut out of circulation.

When a drum of finished soap is released for the grease-making section of the continuous grease plant, a second drum is being loaded with soap-making ingredients and the third drum of the system is being placed in the heat-exchanger circuit. The 3-way valves shown in the flow chart permit drums being cut in and out of the circuit.

GREASE FINISHING AND PACKAGING

Since the soap must be mixed with lubricating oil to form grease, the oil must be of the proper type and grade. Three tanks each of 3,000 gal. capacity can store enough oil for three days' operation of the grease plant. The oil in the tanks can be heated to make blending easier. Blending is aided by agitating oil mixtures with

(Continued)



Newly-developed Lancaster mixer continuously blends soap and oil.

compressed air. Once it is decided that the proper oil or oil blend is ready, it is necessary to maintain it at a precise temperature for mixing with the soap. An automatic temperature-control system employing a heat exchanger, and a thermocouple attached to the finished grease line, is used to control the oil temperature.

The principal unit of the grease-making system is a Lancaster mixer, or disperser. This comprises a system of gears in a housing. The gears, operating at 3,600 rpm. fit the housing closely so that as soap enters the housing from one end and oil from the opposite end they are blended under violent agitation.

The Lancaster mixer, developed by Lancaster Processes, Inc., New York City, recycles the greases within its housing, the rate of recycling depending on the rate of feed. The feed rates of soap and oil can be altered and controlled. When a grease maker is "on the gauges," he watches flow meters which indicate the rate of flow of oil and soap. He can alter the feed rate for different grades of greases and also control the production rate of the mixer. The Lancaster can be made to produce up to 50 lb. of finished grease per min. The grease maker can set controls so that production of one grade of lime-soap grease is being sent to the packaging line while another grade of grease follows immediately, with very little mixing of the two grades of grease.

Grease from the Lancaster is forced through a motor-driven strainer. Between the strainer and the packaging stations, the grease is automatically sampled by a pressure viscosimeter. Grease samples are automatically removed from the grease delivery line and passed through this unit. The samples are checked for consistency and automatically returned to the outgoing grease line.

Adapted from Esso Oilways (Esso Standard Oil Co.)

With falling-film type HCl absorbers you can . . .

Control Weak Acid Temperature for Best Results

The weak acid control method is unique in that it permits the product acid concentration to vary such that the absorber always produces the strongest possible acid with an HCl-free vent.

W. M. Gaylord

NOTE: *The object of automatic control of HCl absorbers is to maintain optimum performance with wide fluctuations in gas feed. Whereas an absorber can be run as well without as with automatic control for any one set of steady conditions, automatic control assures a uniform product, decreased vent losses, and more stable operation with less attention by the operators.*

CONTROL of the gas-water ratio by maintaining a constant weak acid temperature is the most universally satisfactory type of automatic controller for falling-film type absorbers. This is because: (1) Vent losses can be controlled to a negligible value while producing the strongest possible acid at all times. (2) The control equipment consists of standard, low cost temperature regulators. No special corrosion resistant parts except thermowells are required. No auxiliary boilers or sampling chambers are required. (3) It is independent of changes in feed gas HCl content. (4) Stable control is easily attained with properly sized motor valves because the total lag in weak acid temperature control is less than for any other control method independent of feed gas composition.

ABSORBER OPERATION

The falling-film type hydrogen chloride absorber is a combination of two independent pieces of equipment (Fig. 1). A tower is mounted above a tube and shell heat exchanger to provide gravity flow of the absorbing liquor. The gas to be absorbed is fed to the inlet just above the fixed tube sheet of the heat exchanger, which is called the cooler-absorber. The gas proceeds down the tubes of the cooler-absorber, countercurrent to the cooling water in the shell but cocurrent with the absorbing liquor. Any gas remaining at the bottom of the cooler absorber passes up the gas return line into the bottom of the tails tower, the weak gas being scrubbed countercurrently by the water introduced to the absorber at the top of the tails tower. Weak acid produced by the tails tower flows by gravity through a downcomer or seal leg to the top tube sheet of the cooler-absorber. Tangential V-notch weirs attached to the top of every tube distribute the weak acid as a film of liquid down the tube. Hence, each tube functions as a water cooled wetted-wall column. The product acid is removed from the absorber through a seal leg located just below the bottom tube sheet.

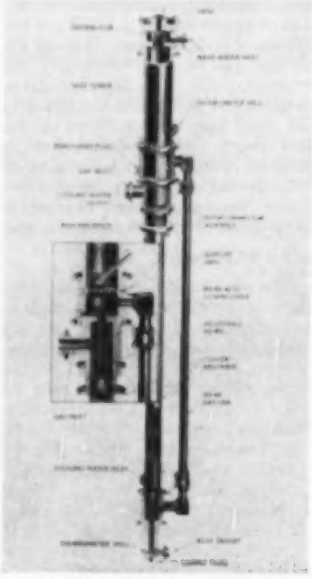


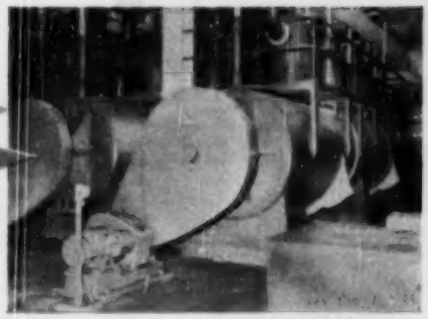
Fig. 1—Karbate Model 6B Falling Film HCl Absorber to which weak acid temperature control may be applied as in Fig. 2.

VENT CONDITIONS

Impervious graphite falling-film absorbers, in taking advantage of the full length of standard $\frac{3}{4}$ in. I. D. × 108 in. long tubes, have sufficient capacity to remove over 90 percent of the heat of solution of hydrogen chloride as sensible heat in the cooler-absorber. The remainder of the heat of solution is taken up by the rise in tempera-

(*Continued*)

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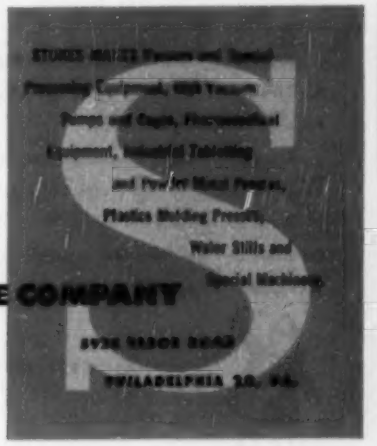


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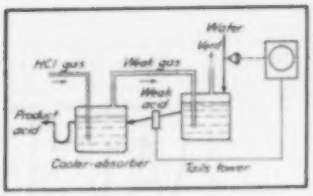


Fig. 2.—Schematic weak acid temperature control arrangement.

QED, cont. . .

ture of the product acid over the feed water temperature. In properly operated absorbers virtually no heat leaves the system as latent heat in the vent gas which would arise from evaporation of feed water. It has been found that if the vent gas is more than a few degrees warmer than the feed water the vent will contain HCl and water vapor in proportions increasing with the vent temperature. The vent temperature is related to the weak acid temperature in that in most cases, a weak acid temperature less than 180 deg. F. will guarantee a low vent temperature and virtually no HCl losses. Although it is theoretically possible to control automatically a falling-film absorber by maintaining a constant vent temperature, it is easier to control the weak acid temperature. The lag in weak acid temperature following load fluctuations is very much less than the vent temperature because there is quite appreciable capacity lag in the tails tower.

WEAK ACID TEMPERATURE CONTROLLER

A simplified flow diagram of the falling-film absorber (Fig. 2) shows the weak acid temperature control arrangement. The cooler-absorber and tails tower have been reduced for this purpose to their function as mixing vessels. Approximate temperature lags of the principle components are 0.03 min. for the cooler-absorber, 0.2 min. for the tails tower, 0.5 min. for the temperature bulb, and 0.2 min. for the motor valve. This small lag in the cooler-absorber follows because gas velocities in it range from 10 to 80 fps. The lag usually does not exceed a total of 1 min. and in some installations has been found to be of the order of ¾ min. total.

The basic principle of the weak acid temperature controller was proved in a crude way in 1943 during initial operation of a medium sized absorber in New Jersey. An engineer was stationed at the base of the tails tower where he could feel the weak acid temperature. Another engineer adjusted the feed water valve according to his instructions. By trial and error

the correct valve position to produce a barely warm weak acid was found. In this manner, production of strong product acid was quickly arrived at without instruments of any kind. Although there have been problems, all of the advantages anticipated for automatic proportioning of water to feed gas by weak acid temperature control have been realized for falling-film absorbers.

Weak acid temperature for a given set of absorber conditions is related to the product acid strength up to the point where vent losses become appreciable. This qualification is necessary because when vent losses reach even a few percent, the weak acid temperature tends to become constant at some value between 180 and 210 deg. F. Up to 180 deg. F. the weak acid will be approximately 10 deg. F. above the feed water temperature for each weight percent HCl in the weak acid. This rough rule states that 10 percent weak acid made from 70 deg. F. feed water will be at 170 deg. F.

OTHER CONTROL DEVICES

The four automatic proportioning devices described next can be applied to any type of hydrochloric acid absorber including the falling-film type. They resemble each other in that the controlled variables have no relation to the vent of the absorber. Any of these controllers can be set to call for product acid stronger than the absorber can make without excessive vent losses. This could be done unintentionally through a control setting satisfactory at a low gas rate which would cause vent losses at an increased gas rate. Each controller has one or more disadvantages which make it less desirable than the weak acid controller from the over-all standpoint.

CONSTANT FEED GAS RATE CONTROLLER

Perhaps the simplest and most nearly foolproof arrangement which can be devised is a control setup to hold the gas and water rates constant when the absorber duty is to take a constant amount of feed gas from a larger gas stream of constant composition. This control method can often

(Continued)

IS BIGNESS BADNESS?

"During the years of 1936 to 1945, Hope College, Juniata College, Monmouth College, St. Olaf's College, and Oberlin College combined produced more candidates for the doctor's degree in chemistry than did Johns Hopkins University, Fordham University, Columbia University, Tulane University, and Syracuse University, all together."

JOHN R. STEELMAN
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QED, cont. . .

be applied to absorbers taking gas from hydrogen and chlorine combustion chambers which are usually operated at very constant rates. In practice, this control method is arranged by putting a constant flow regulator in both the feed gas and water lines. The control equipment for constant rate controllers is standard, inexpensive, and gives optimum results within its rather limited range of application.

GAS-WATER PROPORTIONING CONTROLLER

Proportioning the feed water or acid to the feed gas automatically by conventional flow proportioning equipment is an obvious and practical control method. Practically the only requirement and limitation of gas-water proportioning controllers is that the feed gas be of relatively constant composition. Mannheim furnace gases, and many chlorination byproduct gases are not of sufficiently uniform constitution to enable this method to be applied. Unfortunately, these gases constitute the bulk of hydrogen chloride produced in the United States today. Also, flow rate controllers are in a considerably higher price class than temperature and pressure (constant flow) regulators.

SPECIFIC GRAVITY CONTROLLER

Specific gravity controllers appeal because of their directness in controlling the product acid itself. Another important advantage is that they are independent of changes in feed gas composition. However, they are custom built with the attendant costs and the sampling chamber introduces appreciable capacity lag which complicates stable control.

PRODUCT ACID BOILING POINT CONTROLLER

This control method is based on the control of the boiling point of the product acid. It takes advantage of the approximately 18 deg. F. change in boiling point for each weight percent change in HCl content of acid in the range 30 to 36 percent. All that is necessary is to provide a small boiler in which a portion of the product acid stream can be brought to the boiling point. A conventional temperature regulator controls the boiling point by varying the feed water rate to the absorber.

This arrangement is independent of changes in feed gas composition and employs the simplest of standard temperature regulators. A boiler-sampling chamber constructed around a 2-in. glass tee with 800-watt electrical input has a lag of approximately 4 min.

This much lag makes it difficult for this type of controller to cope with rapid fluctuations in gas rate.

W. M. Gaylord, National Carbon Division, Union Carbide and Carbon Corp., before the annual meeting of the Electrochemical Society, Cleveland, April 19-22, 1950.

ACETALDEHYDE

. . . Cheaper Synthesis

James M. Church and H. K. Joshi

An economical method for manufacturing acetaldehyde promises substantial savings in the production of pharmaceuticals, plastics and synthetic paints and varnishes.

In the past year 500 million pounds of the chemical was used as a starting material for the synthesis of a host of chemical products.

The new method offers (1) greater economy in terms of the starting material; (2) lower processing costs; and (3) valuable byproducts.

Ethyl alcohol, the starting material, is converted into acetaldehyde by partial dehydrogenation. This gives a diluted product of half hydrogen, half acetaldehyde. Recovery is comparatively simple and the hydrogen byproduct is quite valuable in its own right.

The operation of the process is simpler and better than the present commercial processes of hydration of acetylene (small yields, difficult separations, dangerously explosive) and oxidation of ethyl alcohol (acetaldehyde highly diluted with nitrogen).

James M. Church and H. K. Joshi, Columbia University, before the Division of Industrial and Engineering Chemistry, American Chemical Society, Chicago, Sept. 4, 1950.

INDUSTRIAL MOBILIZATION

. . . Chemical Corps Setup

A. C. McAuliffe

At the time of the outbreak of the Korean war the House had voted to channel about $36 million of the '51 budget to the Chemical Corps. The shooting in Asia, however, soon changed the complexion of that amount. Front-line commanders began a flood of requisitions that depleted existing stocks of the Corps. The upshot was that of the $10 billion additional defense funds requested by the President, $31 million became earmarked for the Chemical Corps.

Right now industrial mobilization is in the hands of the Munitions

(Continued)



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A manufacturer requiring good limestone has only to look at Oklahoma - - and he will find what he needs. For limestones are widely distributed over the entire state.

In the Arbuckle Mountains, limestone deposits have a combined thickness of about 8,000 feet (if the dolomites are included). Physically, Oklahoma limestones range from friable or chalky to stone with maximum crushing strength; from coarsely crystalline to very fine-grained; and from minutely oolitic to coarsely pisolitic. Chemically, they range from impure stone suitable for woolrock to chemical grade.

Oklahoma limestone is being utilized extensively for many purposes. Its quality and availability merit consideration for a multitude of additional uses.

TYPICAL ANALYSIS
(26 feet)

	Percent
CaO	54.760
MgO	0.680
SiO_2	0.143
Fe_2O_3	0.074
Al_2O_3	0.174
P_2O_5	0.007
SO_3	0.008
Ignition loss	43.940
Total	99.786

Detailed information on Oklahoma's mineral resources is available on request, based on data by the Oklahoma Geological Survey. Map showing location of mineral deposits is also available.





QED, *cont. . .*

Board. Military aspects are four: (1) maintenance of reserve plants; (2) acquisition and maintenance of essential machine tools and manufacturing equipment; (3) planning studies and industrial preparedness measures; and (4) planning within the Department of Defense.

As part of the setup, the Chemical Corps is authorized to procure all chemical supplies, not only for other arms and services of the Department of the Army, but also for the Navy and Air Force. In this connection, the Corps has a unique problem: approximately 90 percent of its materiel is strictly military in nature, having no civilian counterpart. Some of the newly developed items have never been produced by industry. Others have never been produced in the quantities required by the strategic plans of the Joint Chiefs of Staff. But many of these problems are being solved through our industrial preparedness contracts with industry, and through the procurement planning program of the Corps.

Basing their decisions on past experience and detailed studies of industrial facilities, the procurement planning office analyzes and places tentative production schedules on the Corps' six chemical procurement districts. Main offices of these districts are located in Boston, New York, Atlanta, Chicago, Dallas and San Francisco. Their mission is to locate potential prime contractors qualified to produce desired items, and who have industrial facilities situated within the jurisdiction of the district.

Gen. Anthony C. McAuliffe, Chief Chemical Officer, U. S. Army, before the Armed Forces Chemical Association, Chicago, Sept. 6, 1950.

WATER POLLUTION

. . . *What Must Be Done*

Mark D. Hollis

The quality of our water resources has steadily diminished since 1940. This means added responsibility to safeguard the operation of our industrial machine. Industry can be reduced in capacity, prevented from expanding, or even wiped out for lack of water of sufficient volume and quality. Many of us know that in some river basins in this country we have approached critical conditions between water quality and the uses to which the waters must be put.

Pollution of our surface streams is the resultant byproduct of twentieth century development. At no time during this century has the upward trend of pollution been checked.

Decade by decade stream conditions have grown progressively worse. By comparison over the past decade including the war years, the rate of increase has been alarming. Simple mathematics will show that over wide areas stream conditions are reaching the critical stage.

As we blueprint action for the predictable future, aggressive remedial measures in critical areas should be subordinated only to the most urgent defense needs. The broad question of priority considerations will be placed before the Water Pollution Control Advisory Board at its next meeting.

In terms of what we know and what we have yet to find out there are 20,000 significant sources of pollution in the United States. Besides, we know that more than 5,000 of the 10,000 U. S. industries produce organic wastes. Two thousand of these produce wastes equivalent to a population of over 40 million. The other 3,000 plus industries produce organic wastes of which we have no measure.

In July 1949, the Congress made the first appropriation to the Public Health Service to carry out certain provisions of the national Water Pollution Control Act of 1948. Under a plan developed jointly between the states and the Public Health Service, and in cooperation with other federal agencies, the service has proceeded to assemble basic factual information about the water pollution problem facing the Nation. Summary reports will be published during December.

In terms of over-all national needs, nearly 6,000 new treatment plants, replacement of existing facilities, or enlargements or additions are required. From 1915 to date capital outlay for public sewage disposal construction has amounted to nearly $9 billion, indexed to 1949 dollar value. During that period we spent, in addition, over $1 billion for maintenance and repair.

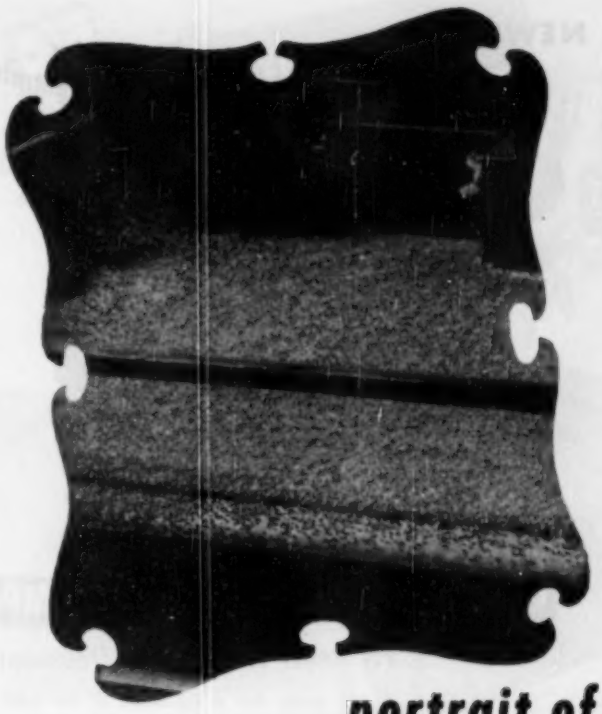
Municipal expenditures during 1949 totaled $277 million indicating public support of water pollution control. Regarding future need, a recent estimate by Twentieth Century Fund in their study of American capital requirements indicates that about $4½ billion for municipal treatment works is required to satisfy our more obvious needs by 1960. Based on the number

(Continued)

INVENTORY BUILDUP?

"Our nation today is using 100 million tons of steel to produce a smaller quantity of goods than it manufactured out of only 88 million tons, seven years ago."

BENJAMIN F. FAIRLESS, *President U. S. Steel Corp.*



portrait of a profitable phenomenon

"Separation by specific gravity through air-flotation" – not a rare scientific event, but a standard chemical processing procedure!

Day in, day out, in hundreds of plants – tons of dry industrial products pour off the decks of Sutton Specific Gravity Separators and Air-Float Stoners installed throughout the chemical processing world.

No other type of equipment can match the famous S S & S Process for profitable and effective solutions to the problems of minimizing the margin of human error; of applying more infinite control over cleaning and classifying methods; and of reducing product shrinkage when it is necessary to process "off-grade" materials.

Interested? Contact the S S & S product engineer nearest you – or, write for free illustrated literature. (See coupon below.)

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NEW! NEW!

FOUND: A New Master for Vital Pumping Controls

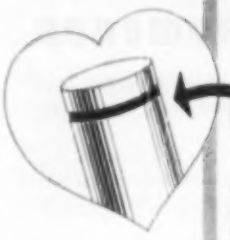


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CHEMICAL APPORTIONING PUMP

For Boiler Feed-Water Treatment

A new pump that is far ahead of the field! The "precisioneering" features of the Neptune Pump bring *finer controls* . . . a dependable performer for all those assignments where continuous chemical feeding is an important part of industrial operations.



NEPTUNE "O" RINGS*

. . . . heart o' the pump!

This is a vital new development offered in the Neptune Pump. Old problems of leaking packings and scored pistons are banished by the unfaltering service of Neptune "O" Rings. New economies in operation and upkeep!

Other advanced features are the Neptune *4 Stainless Steel Valves,* two discharge and two suction . . . plus the *"Self-Adjusting" Universal Joint* which keeps pump parts in alignment.

*Patent Pending

AGENTS

The wide appeal of this new pump is calling for representatives in many areas. Write and we shall send details on a new selling opportunity.

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QED, cont. . .

of industrial plants and needs previously noted, a conservative estimate of an equal value for industrial costs is made.

Mark D. Hoilis, Public Health Service, before the Federation of Sewage Works Association, Washington, Oct. 9, 1950.

REFORESTATION

. . . With Synthetic Humus

Eduard Farber

While reforestation is the long-range remedy, immediate means of replacing topsoil are required. The processing of low-grade waste cellulosic materials under the action of acid catalysts and moderate heat offers a way from sawdust to soil amendment.

Preliminary tests of the chemical process have given very promising results. When 10 to 40 tons per acre of the converted sawdust were applied to the soil, seeds germinated earlier and at a higher rate, leaves were bigger and greener, and the weights of produce like radishes, beets, onions, and tomatoes, were greater.

In logging we select the sound part of the tree to make lumber and discard more than half of the tree. A relatively small part of these low-grade cellulosic materials has been used in processes of reforming in which they are separated into the structural fiber elements and recombined to form building boards. The larger part will have to be subjected to chemical conversions. A number of chemical reactions have been found. A selected few of them have succeeded in getting out of the laboratory into commercial operation and others may soon follow.

A particular kind of condensation takes place under the influence of small proportions of mineral acids, at temperatures well above the boiling point of water and still far enough below that degree of heat at which cellulosic materials are converted into char. This condensation is mostly a reaction of the cellulose. It forms humus-like substances by loss of water and some side reactions. We need products which act like humus to improve our soils.

There is today an arsenal of chemical methods for utilizing low-grade

CRADLE TO GRAVE

"There is only one essential difference between Socialism and Communism. Under State Socialism human liberty and human dignity die a little more slowly."

ELMER L. HENDERSON, M.D., *President American Medical Association*

cellulosic materials. At least two of these methods are in large scale operation, one for the production of furfural, the other for sugar from wood. Two or three additional methods are ready for industrial applications, others need continued study of technical feasibility and commercial value.

Eduard Farber, Timber Engineering Co., before the Division of Cellulose Chemistry, American Chemical Society, Chicago, Sept. 7, 1950

MARKET RESEARCH
. . . *And the Future*

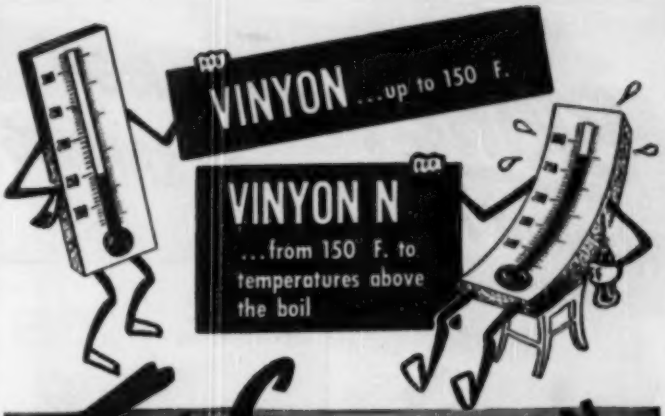
S. D. Kirkpatrick

Not long ago I sat beside a famous corporation president at a lunch and somehow or other the talk got around to research. He volunteered the information that in his company, market research was one of their best money earners. He said it did a lot to keep him out of the sort of troubles that the other kinds of researchers were constantly getting him into. I asked him why—and he said it was because his market researchers always talked in terms he could understand—in dollars and common sense. He said that he hired introverts for scientific research and extroverts for market research—the former were always more inclined to be specialists, the latter generalists.

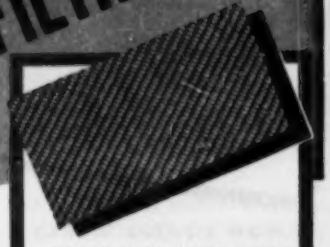
And this led to some rather interesting observations as to what the present trend toward specialization was doing to an organization such as his. It seems that his company like a good many others we all know about came out of the war with most of its top jobs filled with older men. They had carried a heavy load and the physical strain was beginning to tell on them. So in this particular company there was need for a whole new crop of executives. And, surprisingly enough, there were all too few younger men ready to step into the senior jobs. Why?

There were several obvious reasons, like the high-turnover in war jobs and the failure to recruit replacements. But the most disturbing situation of all, my friend discovered, was that some of the very best men in the organization had become so specialized in their work and viewpoints that they were unwilling or unqualified to accept broader responsibilities. In other words, his organization had become compartmentalized. There were too many vertical functions, too few horizontal. Interdepartmental communications were inflexible and inefficient. Research communicated with sales only at the vice-presidential level. Production and sales had operated so independently that at one

(*Continued*)



Tops for broad-range CHEMICAL FILTRATION



NFM VINYON† and VINYON N† are excellent general purpose filter cloths. They are available in a variety of weaves and in any desired standard width from 26" through 72" or as made up filter element covers.

Over Forty Years of weaving experience have given us the "know how" so necessary to the production of top quality Industrial Filtering Fabrics. We weave all of our Synthetic Fiber Cloth including Glass, Nylon, ORLON* (an acrylic fiber cloth), Saran, VINYON†, and VINYON N†.

Write us about your requirements, we'll be glad to send test cloths, if you are not sure which cloth material is best.

*TM — E. I. duPont de Nemours
†TM — C & CCC

"Excellent Resistance—No Attack" are the operating reports when these filter cloths are used for filtering:

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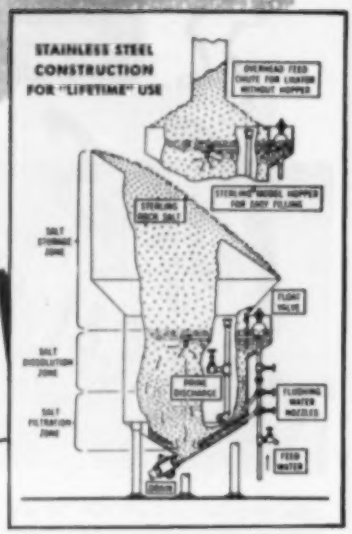
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JUST TURN IT ON!



STERLING ROCK SALT
BRINE DELIVERED BY PIPE TO EVERY POINT OF USE IN YOUR PLANT—



HOW LIXATOR WORKS

In the dissolution zone—flowing through a bed of Sterling Rock Salt which is continuously replenished by gravity feed, water dissolves salt to form 100% saturated brine. **In the filtration zone**—through use of the **self-filtration** principle **originated by International,** the saturated brine is thoroughly filtered through a bed of undissolved rock salt. The rock salt itself filters the brine. Nothing else is needed.

WHAT THE LIXATOR PROVIDES

- ✓ **Chemical and bacterial purity to meet the most exacting standards for brine.**
- ✓ **Unvarying salt content of 2.65 pounds per gallon of brine.**
- ✓ **Crystal-clear brine.**
- ✓ **Continuous supply of brine.**
- ✓ **Automatic salt and water feed to Lixator.**
- ✓ **Inexpensive, rapid distribution of brine to points of use by pump and piping.**

Savings up to 20% and often more in the cost and handling of salt have been reported by many Lixate users. Why not investigate?

• You can eliminate shoveling, hauling, and laborious hand stirring of salt and water, and frequent testing of the brine strength—with International's Lixate Process for Making Brine. Stops waste through spilling. Saves time and labor. Assures accurate salt measurement . . . no guesswork.

• In the production of chemicals, leather, textiles, plastics, soap, sulphonated oils, petroleum products, food products, in refrigerating equipment such as spray decks and unit coolers, in regenerating zeolite water softeners, the Lixator provides an extremely easy way of measuring salt accurately in the form of brine. YOU SIMPLY TURN A VALVE for self-filtered, LIXATE Brine that ideally meets the most exacting chemical and bacterial standards for every use.

An INTERNATIONAL Exclusive

The LIXATE* Process

FOR MAKING BRINE

*REG. U. S. PAT. OFF.

INTERNATIONAL SALT COMPANY, INC., Scranton, Pa.

QED, cont. . .

time each had actually engaged different firms of efficiency engineers to find out what was wrong with the other department!

My friend, who incidentally came into his job from the Armed Services, lost no time in cleaning up this situation. In this process, he got most help from the market research men. The only trouble was that there weren't enough of them to fill all the jobs. So he asked my help and the best I could do was to send him the membership roster of CMRA!

Some of these thoughts were in my mind last Friday out at Oakdale, L. I., when I heard the great farmer-novelist, Louis Bromfield, speak in a panel that helped to dedicate Lauren Hitchcock's wonderful new laboratories. As he was talking about the farm problem and farmers, I was thinking about Market Research and Market Researchers. By the simple process of changing a few words, I found that Bromfield was writing my speech a lot more eloquently than I could ever hope. Will you forgive me, therefore, if I read a couple of paragraphs of the Kirkpatrick version of the Gospel according to L. Bromfield?

"The market researcher cannot be a specialist. By the very force and character of his job he is obliged to live in close contact with all of the elements of business and industry. Moreover, he is obliged to live in close contact with all the elements of human society and civilization. The good market researcher is a broadly educated man in the sense of the thinker and doer of the Renaissance. By necessity he realizes that no fact of science and no element of humanity occupies an isloated and detached place in the broad scheme of things. Every fact and every discovery is related to countless other factors and as science advances it becomes increasingly clear that all facts and all discoveries are part of an immense and complex pattern. Man can dominate his environment and solve his problems completely only when the entire integrated pattern becomes evident through the discovery of all the parts and the intricate fashion in which they fit together."

"It is my own belief," (and now I quote Mr. Bromfield's exact words) "that the greatest single weakness of our contemporary civilization is its tendency toward over-specialization—to put an undue importance on expertness in a single field while ignoring the Renaissance conception that a really educated man is one who stands in awe of the universe and is constantly striving to penetrate deeper

FISH TO FRY

"It's a fact that the people who do most are the ones who have time to do more, but the busiest people in the world are those who accomplish the least."

R. P. WILHELM, *Sales Consultant Monsanto Chemical Co.*

and deeper into a clear understanding of all the parts and their relationship to the whole. In our times over-emphasis on specialized research has led increasingly to the seeking of answers down certain narrow channels, while ignoring the countless variables and their relation to the whole. All too often this overspecialization tends to lead into blind alleys and false assumptions and to produce laboratory and research technicians who are little more than glorified drug clerks. This is not a fault alone in the exact sciences but in the liberal arts as well."

What does all this mean if we try to translate it into our problems, our jobs, our futures? To me it is a reminder and a warning. The growing profession of market research—and it is still in its infancy—can develop strength, stature and influence only as it develops practitioners who are broadly qualified to serve all the needs of management in an ever-expanding field. There will be less and less opportunity for the narrow specialists to collect data and prepare reports with pretty, meaningless charts and conclusions. There will be greater need for well-rounded, well-grounded investigators who will come up with sound over-all programs that tie together all the facts and factors that make for Bromfield's pattern of progress in American industry. I am confident that our next five, ten or twenty years will be profitable and productive for market research and market researchers—provided we continue to grow in both the breadth and the depth of one participation in all of the affairs of our industry and professions.

S. D. Kirkpatrick, *Chemical Engineering*, before the Chemical Market Research Association, New York, June 8, 1950.

INFORMATION

. . . *In a Hurry*

Calvin N. Mooers

A proposed reading machine would be able to search the entire library of Congress in ten seconds, select all the information on a given subject, and print selected abstracts at the rate of ten a minute.

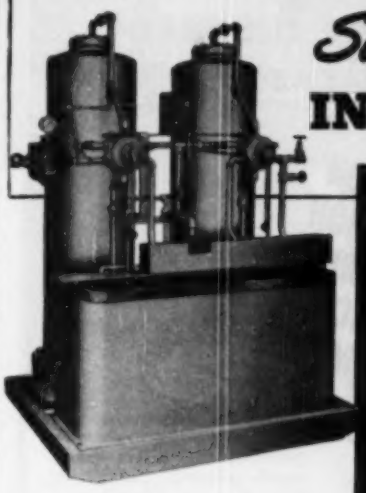
The machine would make it possible to furnish bibliographic searches in response to any request by return

(*Continued*)

ion exchanger

Suggestions by

INDUSTRIAL



Demineralization of Water

Deacidification of Solutions

Purification of Organic Solutions

Recovery of Valuable Metals from Solutions

Concentration of Solutions

Substitutions of Anions and Cations in Solutions

A Two-Bed INDUSTRIAL *Ion-Exchange Unit. Standard two- and four-bed units available with capacities of 200 to 1000 gph. Special units of any capacity engineered to requirements.*

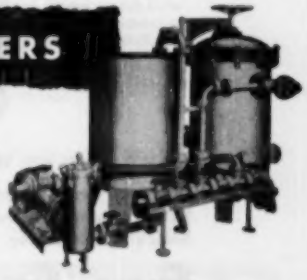
The success stories of ion exchangers are not isolated cases. All through industry in a wide variety of applications they are effecting substantial cuts in costs, more uniform products, and a new ease in process control.

Here are a few suggestions for you to check against your own processing. INDUSTRIAL is glad to give you the benefit of its experience if you will outline your requirements. An estimate of probable savings, production, approximate costs, and the equipment required will enable you to know what the ion-exchange method can do for you.

INDUSTRIAL FILTERS

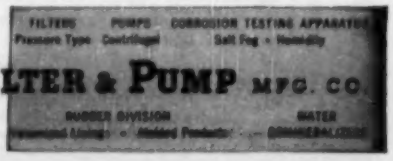
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Any Solution—Any Quantity



A Typical INDUSTRIAL *Stationary Filter. Standard portable and stationary models available with capacities of 100 to 15,000 gph. Special filtering systems are engineered to meet unusual requirements.*

Write for full information and recommendations.



INDUSTRIAL FILTER & PUMP MFG. CO.

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You probably have thousands of dollars invested in insurance for all kinds of protection... but what insurance have you against corrosion in chlorine manufacturing equipment? You can be sure you will avoid costly shutdowns by using General Ceramics Chemical Process Equipment... a name synonymous with corrosion prevention. Here's why!

Where the chlorine process demands material with high thermal shock resistance, General Ceramics has developed stoneware SP-22. In the cooling equipment which requires a material with high heat transfer properties, General Ceramics has designed cooling tubes made with stoneware B-41. The cascade type drying tower with internal spreader plates is also made with Chemical Stoneware which *is inherently corrosion-proof* against all acids and gases (except HF and strong hot caustics).

For complete information on General Ceramics chlorine manufacturing equipment write for circular A. For information on other General Ceramics corrosion-proof equipment... any one of the offices listed below will be glad to forward the necessary information. Ask for Bulletin CHE-R3.



YOU SAVE 3 WAYS WITH GENERAL CERAMICS' $$$*

Savings through uniformity of construction... no misfits.
Savings on shipping costs... one shipment for everything.
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Our Insulator Division Manufactures Steatites, Porcelains.

*Single Source of Supply. — Titanates, Ferrites

QED, cont. . .

air mail, giving an overnight service to information users.

This whirlwind documentary engine, or Doken, would employ microphotographic film wound on a drum 10 ft. in diam. and 7 ft. long. It would have a scanning head, an electronic or magnetic memory device, and an optical copying television head. Micrographic copies of the 200-word abstracts of documents would be carried on large, semi-transparent sheets, with from ½ million to a million abstracts on each sheet. The stack would be only about 20 ft. long and would fit nicely into an ordinary large-sized room.

Few private companies have scientific files large enough to justify the tremendous investment needed. Even such extensive information files as the Atomic Energy Commission's 40,000 scientific reports would be easily within the capabilities of smaller machines, which can handle more than 100,000 items.

The question is whether the worldwide torrent of scientific information —an estimated 30,000 periodicals and 1,000,000 papers a year—can be met by any conceivable retrieval machine. The answer is yes. And the backlog (estimated roughly at 100,000,000 pieces) can be handled too.

The fastest electronic tabulating machinery would seem to require about 2,600 hr., or about three and a half months, to scan a collection of 100 million pieces in answer to one request for information. The microfilm rapid selector, according to published speeds, would take about 170 hr. of steady running time, or about a week, to make the same search. Both these are too slow to meet the reasonable requirement that a central agency having such a machine should be able to make a number of searches each day, and to send out the bibliographies the same day the request is received.

A machine that can do this job is actually possible—and it can be constructed within the limitations of our present technology. The great expense is not in the machine. The real cost is handling the multitude of information in setting up the system. We should figure on a cost of at least $2 per item. Thus the anual cost of processing the world's information—$2 million—would be several times the cost of the machine itself.

Part of the world's intellectual output is already being abstracted. With cooperation, and less than 10 percent additional effort, this same information could be put into a Doken system. Perhaps this cooperative endeavor will take the pattern so well

SWEET FORECAST

"The potential production of sugar is so vast in relation to its present demand for food purposes, that it must be regarded as an industrial resource of first importance."
ROBERT C. HOCKETT, ***Scientific Director The Sugar Research Foundation, Inc.***

worked out by *Chemical Abstracts* with its large corps of volunteer abstractors, and a smaller staff of central editors. If so, the cost of the world-wide documentary project could be whittled down to manageable proportions. Support could be on a subscription basis.

Smaller versions of the same instrument have a possible use in the whole chemical literature, the United States Patent Office, or the files of insurance companies. In such smaller collections, a much more complete subject coding is possible, and would certainly be desirable in the case of patents.

Calvin N. Mooers, Zator Co., before the Division of Chemical Literature, American Chemical Society, Chicago, Sept. 5, 1950.

FREEZE DRYING

. . . *Radiant Energy*

W. H. Zamzow and W. R. Marshall, Jr.

Freeze drying of life saving biologicals like blood plasma, vaccines and hormones can now be accomplished 4 to 16 times quicker with radiant energy.

Feed stock containing large amounts of water and 1 to 50 percent solids is first frozen solid at 0 deg. F. in a container of glass or special transparent plastic. Then comes radiant heat in a vacuum chamber. The ice changes to water vapor without going through the liquid state. A porous mass which can be ground to a dry powder is left.

Original cost of equipment for radiant drying of frozen material is about the same as for conduction drying but the 4 to 16 fold increase in capacity by radiant drying gives a much lower unit cost based on the product.

W. H. Zamzow and W. R. Marshall, Jr., University of Wisconsin, before the American Institute of Chemical Engineers, Minneapolis, Sept. 13, 1950.

INDUSTRIAL RESEARCH

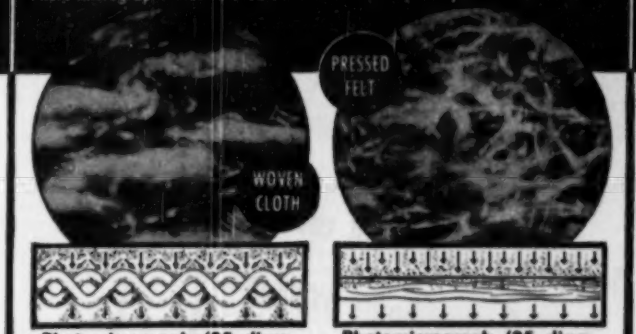
. . . *Profit Insurance*

W. A. LaLande, Jr.

Does industrial research pay? As Al Smith used to say "Let's look at the record."

(Continued)

IT MUST BE FELT
To Be Efficient in Dust Collection
Photo-micrographs illustrate value of wool felt as a superior filter medium



Photomicrograph (25 diam. enlargement) of ordinary filter cloth . . . Drawing shows how dust can escape through open mesh.

Photomicrograph (25 diam. enlargement) of special, pressed wool felt . . . Drawing shows how dust particles are trapped by the density of the felt while air flows through in constant volume.

Even the split-micron dust particle will not penetrate the microscopic pores of the cylindrical bag of special felt in a MIKRO-COLLECTOR.*

Moreover, the bag is kept constantly clean by the Hersey automatic, reverse-jet cleaning ring which flexes the bag while moving up and down its outer surface—thus assuring free airflow, phenomenal filter rates and far higher capacity per given area of filter fabric.

Put these two features together and you have the reason why a MIKRO-COLLECTOR not only TURNS YOUR DUST INTO DOLLARS but stops those many dollar losses due to inadequate dust control.

SEND FOR *actual sample of felt that makes the* MIKRO-COLLECTOR *so outstanding . . . also case histories revealing dollar and cents savings through its use.*

*Patents applied for by H. J. Hersey, Jr., and Pulverizing Machinery Company.

PULVERIZING MACHINERY COMPANY
55 Chatham Road Summit, New Jersey

MIKRO-COLLECTOR
Reg. U. S. Pat. Off.
By the makers of
MIKRO-PULVERIZERS and MIKRO-ATOMIZERS

PRESERVE OUR HERITAGE FAITH FREEDOM AND INCENTIVE



$9,100 replacement costs

4,732 man-hours overtime

by installing

one acid-proof

TANTALUM Heat Exchanger

Are you paying for high efficiency, long lasting Tantalum equipment you haven't got? It's quite possible. Replacements, repairs, overtime, shutdowns, loss of product may be constantly adding up dollars of loss that would far more than pay for Tantalum equipment that would free you from these troubles.

Take this case in point from actual records! 1937: a ferrous alloy heat exchanger had been replaced on an average of 2½ times a year at a cost of $700.00. This did not include several hundred overtime maintenance hours, nor time in bringing solution to working heat.

An acid-proof Tantalum heat exchanger was installed. 1949: The record shows after more than 12 years of use it had saved $9,100 replacement costs as figured against the old heater. In addition to its trouble-free operation, this Tantalum heat exchanger saves 7 pre-heating hours every working day in each heating, amounting to 4,732 man-hours of overtime.

If you are looking for dollars-and-cents economy and dependable performance, investigate Tantalum. Fansteel Metallurgical Corporation, North Chicago, Illinois.

Use Tantalum with economy for most acid solutions and corrosive gases or vapors except HF, alkalis, or substances containing free SO_3.

11408

PRODUCTS & SERVICES INCLUDE:
ELECTRICAL CONTACTS
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Fansteel

Acid-Proof
TANTALUM
CHEMICAL PLANT EQUIPMENT

AN INDUSTRY THAT SERVES INDUSTRIES

QED, *cont. . .*

The chemical industry as a whole spends about 2.6 percent of gross sales on research and development, and pays out from $9,000 to $30,000 —depending on the company—for each professional technical man on its research payroll.

What's the result? Here are some case histories to answer that question. Table I gives the story of a new product, a polymeric material:

Table I—Case History for a Polymeric Material

Cost of laboratory research and pilot plant work	$2 million
Cost of developing markets	No data
Commercial plant investment	$15.9 million
Elapsed time from start of lab. work to beginning of production	9 yr.
Expected life of product or process	15-25 yr.
Annual sales or savings	$12.5 million (sales)

Here we have a major research and development project which required the expenditure of almost $2 million for laboratory research and pilot plant, and an undisclosed but substantial amount for market development. In this case the investment for plant facilities was very large, but the estimated long life of the product and the sales which had been forecast supported the expenditures. This has proved to be a highly successful product and justifies in every way the patience and faith indicated by 9 years of experimentation from laboratory to the start of commercial production.

Table II illustrates another aspect of industrial research, an improved product. This time we're concerned with an explosive material:

Table II—Case History for an Explosive Material

Cost of laboratory research, pilot plant work and developing markets	$30,000
Commercial plant investment	$14,000
Elapsed time from start of lab. work to beginning of production	3 1/2 yr.
Expected life of product or process	10 yr.
Annual sales or savings	$120,000 (sales)

This table shows how one company improved on an explosive which was not basically new, but which allowed them to enter the field with a product which was better than competitive materials. In this case the sales volume was small, since the product is sold only to the sportsman trade but the small expenditure for the first three steps and the small outlay for manufacturing equipment justified the expenditures. The profit on this item is very satisfactory and the life expectancy of the product is good.

The last table gives the results of an improved process for the manufacture of an organic chemical:

Table III—Case History for an Organic Chemical

Cost of laboratory research and pilot plant work	$14,000
Cost of developing markets	None
Commercial plant investment	$30,000
Elapsed time from start of lab. work to beginning of production	7 mo.
Expected life of product or process	10 yr.
Annual savings or sales	$90,000 (savings)

This table shows the savings resulting from working out in the laboratory and pilot plant an idea suggested by a chemist who had heard a discussion of some plant problems. The idea was so obvious that several shortcuts were possible and within seven months the preliminary work was finished and the necessary small modification of the existing plant was completed. The savings are very substantial. The estimated life of the "advantage" seems conservative since the chemical involved is an old one, the old process had been in use for 20 years, and the improvement had been missed for all that time.

The answer, then, to the question "Does Industrial Research Pay?" is an ever-constant and enthusiastic "Yes!"

W. A. LaLande, Jr., Pennsylvania Salt Manufacturing Co., before the First Annual Pacific Northwest Industrial Research Conference, Portland, Ore., Sept. 18, 1950.

—*End*

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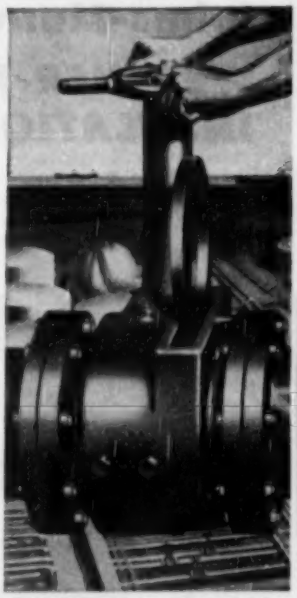
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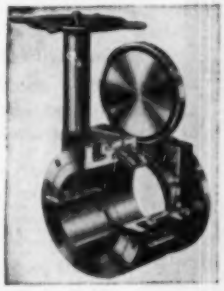
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Chemical Engineer's Bookshelf

LESTER B. POPE, Managing Editor

To the Editor:

Sir:—You may judge by the attached that I like the book by Donald Kern, "Process Heat Transfer."

The fact is that I think it good enough to be the feature of your next book review section and you might play it up with a sketch of the author.

Do what you think best with this, as long as you don't cut out the parts wherein I say it is good.

DONALD F. OTHMER

Professor of Chemical Engineering

Head of the Department

Polytechnic Institute of Brooklyn

We asked Dr. Othmer to review Kern's book. This letter came back with his review.

Four Points Assure Indispensability

PROCESS HEAT TRANSFER. By Donald Q. Kern. McGraw Hill Book Co., New York, 871 pages. $8.

Reviewed by Donald F. Othmer and Ju Chin Chu

On rare occasions a book appears with sufficient merit to assure its future as a technical bible. In its 871 pages Kern's "Process Heat Transfer" assumes a conspicuous position for chemical engineers alongside such enduring predecessors as the treatise by Walker, Lewis, McAdams and Gilliland; the text by Badger and McCabe; and the handbook by Perry. It differs both in appearance and content from any book written heretofore on the subject of heat transfer. And to all who have an interest, academic or industrial, in the applications of heat transfer and the calculations of its apparatus, this new book will prove to be the indispensable companion. This opinion is predicated mainly upon four circumstances: (1) it systematically integrates a field which has seemed so far to be covered only haphazardly; (2) several hundred pages of the material have not appeared in the literature before; (3) the element of "know-how" has been successfully translated into a text; and (4) it contains the solutions of a large number of common and uncommon problems.

The author apparently has undertaken to allot space, as far as possible, to each subject in accordance with the frequency with which it might be encountered by a practicing process engineer. By skillful pedagogy the book proceeds from chapter to chapter increasing students' familiarity, point by point, with general types of process conditions and the means by which apparatus may be calculated to fulfill them. The author, a design engineer of rich experience in building equipment for chemical, petroleum, and power plants, has developed this book as a means of presentation over many years in graduate evening classes.

Where it has been conventional in other texts to treat subjects such as convection, condensation and vaporization as coefficients, "Process Heat Transfer" goes farther to treat exchangers, condensers and vaporizers or reboilers, computing coefficients for both hot and cold fluids conforming to the dimensions of a single piece of apparatus. To maintain the visual aspects of heat exchange during calculation, both parts of the transfer have been computed side-by-side, thus lending considerable clarity and definition to the large number of illustrative numerical solutions. It seems quite probable that this method of demonstrating heat transfer calculations will establish a pattern for those who study, teach, or practice the solution of heat transfer problems. As a further aid to the student and engineer, the calculation steps have references to the part of the text or equations in which they were developed.

In the first of twenty-one chapters the author differentiates between heat transfer and process heat transfer. The latter he identifies with the thermal and fluid flow pattern established geometrically by the standard types of apparatus and their influence upon the design of a process and an apparatus as a whole. Chapters 2, 3 and 4 contain the customary introductory material on conduction, convection and radiation. The chapter on convection is of special merit for a particularly lucid development of elementary dimensional analysis and the detailed development of working equations from experimental data.

Starting with Chapter 5, Temperature, the book is novel. From here on the method, attitude and subject matter differ from what has appeared in the literature before. The influence of the type of fluid flow on the over-all value of the potential for two given sets of temperatures is introduced. This is combined in Chapters 6 through 11 with the development of calculation methods for the double-pipe exchanger, 1-2 exchanger, 2-4 exchanger, and the study of heat recovery and the optimum potential in the thermal processes as related to the form of the apparatus.

Continuing the relationship between hot and cold fluid coefficients, flow patterns and process design, chapter 12, some 60 pages in length, deals with the condensation of a single vapor. However, of considerable value is the generous space given to derivations and the combined latent-sensible heat effects as embodied in such apparatus as the horizontal and vertical types of desuperheater-condensers and condenser-subcoolers. The next chapter, of the same length, deals with the condensation of mixtures. Starting with a novel study of the Gibbs phase rule which any undergraduate should master easily and quickly, the solution of the common cases such as binaries and vapor-noncondensable systems are contained in the first half. The second half covers multicomponent systems and will interest mainly petroleum engineers. The two chapters on condensation are followed by two chapters on vaporization with a total of 136 pages. Chapter 14 deals with evaporation in power stations and chemical plants. A novel feature of this chapter is the solution of the algebraically indeterminate problems of chemical evaporation and a section on thermocompression evaporation. Chapter 15, Vaporizers, Evaporators and Reboilers, is an original presentation of the problems of design in systems having natural and forced cir-

(*Continued*)

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culation vaporization. Such items as the horizontal and vertical thermosyphon (natural circulation) reboilers are developed and calculated in detail as well as their relation to distillation design.

Chapter 16 is a 50 page study of extended surfaces (fins) developing derivations and calculations of the longitudinal and transverse fin types of exchangers. Chapter 17, 60 pages in length, is a comprehensive treatise on diffusional and direct contact heat transfer and is the longest treatment published so far on cooling tower design and selection. Chapter 18 contains much standard and original work on liquid and solid batch and unsteady processes while Chapter 19 covers the empirical calculation of furnaces and fireboxes. Chapter 20 deals with a large number of applications which are not covered earlier in the text by a systematic study. Chapter 21 is an interesting guide to the control and instrumentation of processes wherein heat and temperature control are of importance.

The first eleven chapters, occupying some 250 pages, together with selections from Chapters 12 and 15 on condensation and vaporization, make an excellent text for an undergraduate course. For graduate instruction, the remaining material may be included.

The book is profusely illustrated containing over 400 line drawings and new data curves, a number of which will doubtless find their way into standard reference texts of the future. There is in addition a set of problems and a complete nomenclature at the conclusion of each chapter. A detailed index is also provided.

Rather than a pedantic adherence to a bibliography of scientific researches on heat transfer in the preparation of this text, the author has drawn from the broad fund of industrial data available to him.

There are, however, several places in the text where references to original literature are missing. For example, on page 44, no reference is indicated to "a typical apparatus for the determination of the heat transfer coefficients to liquid flowing inside pipes or tubes" which is illustrated in detail in Fig. 37. There are no references to the last statement about modern theory of velocity distribution. Reference to Fig. 169 concerning the weighted fin efficiency is mentioned.

On page 29 the fluid flow is divided into streamline and turbulent regions at a Reynolds number of 2,100 or 2,300. Some oversimplification of the mechanism is apparent in neglecting a transition region between Reynolds number of 2,100 and 10,000.

RECENT BOOKS RECEIVED

Advanced Organic Chemistry. By R. C. Fuson. Wiley. $8.

Chemical Kinetics. By K. J. Laidler. McGraw-Hill. $5.50.

Organophosphorus Compounds. By G. M. Kosolapoff. Wiley. $7.50.

Physical Aspects of Organic Chemistry. By W. A. Waters. Van Nostrand. $8.

Plant Engineering Handbook. Ed. by W. Staniar. McGraw-Hill. $15.

Progress in Coal Science. Vol. I. By D. H. Bangham. Interscience. $7.

The Properties of Asphaltic Bitumen. Vol. IV. By J. P. Pfeiffer. Elsevier. $6.

Protective Coatings for Metals. By J. W. Gailer & E. J. Vaughan. Griffin. 24s.

Pulp and Paper Manufacture. Vol. I. By J. N. Stephenson. McGraw-Hill. $10.

Structural Chemistry of Inorganic Chemistry. Vol. I. By W. Huckel. Elsevier. $9.

Structural Plastics. By H. C. Engel, C. B. Hemming & H. R. Merriman. McGraw-Hill. $4.50.

The Theory and Practice of Industrial Research. By D. B. Hertz. McGraw-Hill. $5.50.

Treatise on Powder Metallurgy, Vol. II. By C. G. Goetzel. Interscience. $18.

Fig. 27 in Chapter 4 on radiation is reproduced from the original reference. Curves 5, 6, 7, and 8 in the figure which give the factor allowing for the presence of refractory surface have no connection with the accompanying discussion, although the refractory surface is mentioned in a later chapter on furnace calculations.

It has been recognized that high vapor rate in the condenser affects the heat transfer coefficient. The equations for estimating heat transfer coefficients of condensing vapor are derived (pp. 257-263) on the assumption of negligible vapor velocity. In view of its practical importance, it might be desirable to discuss the effect of vapor rate.

On p. 344 in Chapter 12 in the estimation of gaseous diffusivity, the author recommends Gilliland's empirical equation. It is believed that Hirschfelder's correlation is more sound and yields more satisfactory results (*Chem. Revs.* **44** 205 (1949)), especially in view of the discrepancy found in the recent studies on mass transfer.

From p. 54 to p. 57, the author discusses the Reynold's analogy and Prandtl modification of the latter. The author, however, points out that none of them has given satisfactory results. In view of the limited space available for making bibliographic comparison, the up-to-date theory of Von Karman and its modifications (*Trans.* A.S.M.E. **61**, 705 (1939); *Trans.* A.S.M.E. **63**, 447 (1941); *J. Appl. Mech.* **13**, A-77 (1946); *Proc. Natl. Acad. Sci.* **34**, 530 (1948) and **34**, 540 (1948)) would be preferrable to the historic sketch of early developments.

(Continued)



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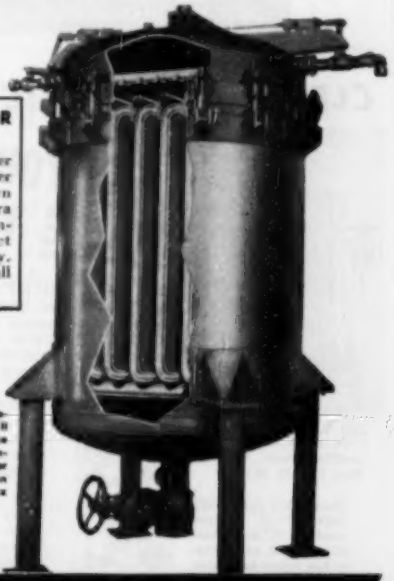
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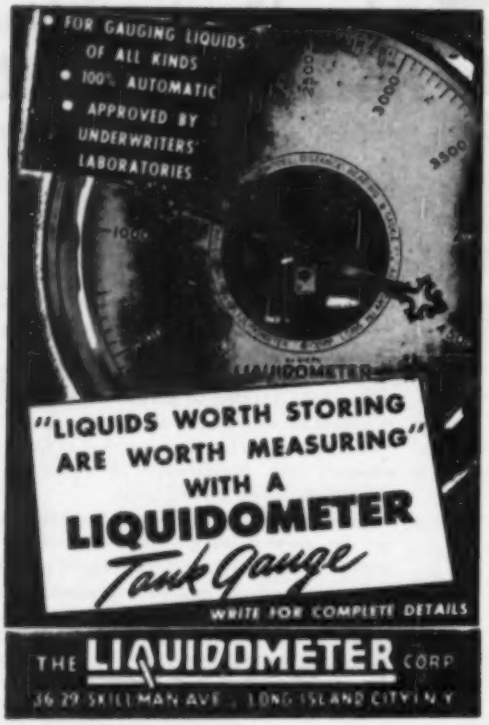
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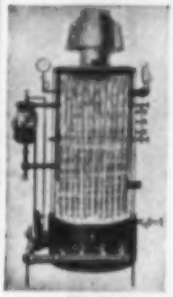
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While Section 9 in Chapter 20 presents an excellent discussion of rod-like heat transfer of the moving bed of granulated solid, there is no adequate discussion of heat transfer of a fluidized system. In view of the importance of fluidization in modern petroleum refining and chemical industries, the inclusion of recent contributions on the heat transfer of fluidized systems would be highly desirable.

Important contributions during the recent years, such as heat transfer in supersonic and subsonic flow, surface boiling, molten metals, boundary layer instability, rarified gases and dissociating gas, transpiration cooling, heat and mass transfer analogy at high Schmidt number, low temperature heat transfer, fouling rates of heat exchangers, etc. have not been included. These recent contributions are important in engineering practice as well as academic literature. Even if their extensive presentation is not permitted, brief review of them, following similar patterns of Prof. McAdams' Institute lecture of A.I.Ch. E. (*Chem. Eng. Progress* **46**, 121 (1950)) would definitely be fitted to Chapter 20 on additional applications. It is recognized that with the time lag in publishing a book of this size, the above listed references were available too late for inclusion in this first edition of a scholarly presentation.

Nevertheless, these are only carping criticisms of what time and wide usage by students and practicing engineers will doubtless prove to be one of the outstanding books for both chemical and mechanical engineers in these mid-century years. Particularly teachers of the subject will find it a fine text for classes. The publishers have contributed by making available this wealth of data and new design methods at less than a penny a page.

Low Pressure

KLEINSTE DRUCKE, IHRE MESSUNG UND ERZEUGUNG. By Rudolf Jaeckel. Springer-Verlag. Berlin. 302 pages. DM 39.60.

Reviewed by F. C. Nachod

This is the ninth book in the series "Technische Physic in Einzeldarstellungen" edited by Professor Meissner. In the present volume Dr. Jaeckel gives a good account of high vacuum technique. The subject is covered by a logical development starting with the kinetic theory of gases, leading on to vacuum measurement instruments, pumps, producing and maintaining a vacuum without pumps,

connections, etc. and concluding with laboratory hints about lubricants, cements and so forth. The text is profusely illustrated, 301 figures, and appendixes as well as indexes are added. There is a wealth of information for the experimenter.

The only disadvantage in the opinion of this reviewer lies in the fact that where reference to commercially available units is made or where standardization is discussed it refers nearly exclusively to German products and thus the usefulness to the American investigator is decidedly limited.

However there is a definite flair of German "Gründlichkeit" pervading the booklet which might indicate a resurrection of the era before 1932.

Getting the Oil Out

ELEMENTS OF OIL RESERVOIR ENGINEERING. By Sylvain J. Pirson. McGraw-Hill Book Co., New York. 441 pages. $6.50.

Reviewed by Kenneth A. Kobe

This text adds another to the growing group of books in the field of petroleum production engineering. The author is a special research associate at the Stanolind Oil and Gas Co. but is also a lecturer in reservoir engineering at the University of Tulsa and previously was a professor at Pennsylvania State College. Thus this book combined the academic viewpoint of a textbook with the practical viewpoint of an industrial reference book. Although stated to be a graduate level text, the book develops the behavior principles of petroleum reservoirs during production. Thus is can likewise be used at the senior level to introduce these principles to the student and to give him an introduction to this book which he can study further either in graduate work or on his own in the field.

The book is divided into seven important chapters. The first two treat the reservoir rocks and structures from first the microscopic and then the megascopic viewpoints. Experimental methods of measuring the properties of the reservoir rock are shown so that the terms used have meaning from experimental work. The two following chapters discuss the reservoir fluid (hydrocarbon gases and liquids and connate water) and the forces and energies that exist in the reservoir. The next two chapters deal with the fundamental equations of reservoir engineering (brief) and production processes (extensive). All of this previous material culminates in a final chapter on analysis of field

(Continued)

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data, illustrated by examples from operating fields.

Each section within a chapter is concluded with a series of references which include papers published through 1949. The book is excellently printed. In addition to numerous illustrations in the text, there are seven fold-out maps of oil fields and their cross-sections, and three other large charts. This book will be widely used and quoted by petroleum production engineers.

Thirtieth

ORGANIC SYNTHESES, Vol. 30. Edited by Arthur C. Cope. John Wiley & Sons, New York. 115 pages. $2.50.

In the usual style, the syntheses of 39 organic compounds have been described in this volume. They include 9-acetylanthracene, *n*-butylacetylene, chloroacetonitrile, glutaric acid, phenylacetylene, *o*-tolualdehyde, vanillic acid, vinyl laurate and other vinyl esters. Procedures in all cases have been checked.—FA

Fat Technology

MELTING AND SOLIDIFICATION OF FATS. By Alton E. Bailey. Interscience Publishers, New York. 357 pages. $7.

Latest of the series of Fats and Oils Monographs, this book "has been written primarily for the practicing oil and fat chemist or technologist."

First object in preparing the volume has been to collect all available material on the subject, from widely scattered sources. Second object has been to correlate and interpret the experimental data.

Of special interest to chemical engineers is the chapter devoted to solubility of fatty substances in organic solvents. There is also a brief and somewhat elementary introduction to physical chemical principles which are relevant to melting and solidification. The author has also attempted to briefly review the more useful laboratory methods and techniques.

The six chapters of the book seem to be thoughtfully laid out and comprehensive in their scope. The subject index is rather meager but the text is liberally illustrated with charts, tables, and pictures.

The book is attractively bound and it will unquestionably prove to be a useful reference volume for anyone working in the field of animal and vegetable fats and oils.—GWM

La Notion de pH

THEORIE, MEASURE ET APPLICATIONS DU pH. By Holger Jörgensen. Translated from the German [into French] by J. Gueron. Dunod, 92 Rue Bonaparte (VI), Paris. 351 pages. 940 fr.

"L'ouvrage de Jörgensen, après ceux de Michaelis et de Clark, a pris place parmi les ouvrages fondamentaux traitant du pH. La sûreté de l'exposé, son caractère concret, la façon résumée et complète tout à la fois dont il est traité en ont fait un 'classique' toujours actuel sur la question parmi une littérature abondante.

Relatant en détail les travaux les plus importants de la recherche physico-chimique et les idées fondamentales dont dérive la notion de pH, l'auteur décrit la technique pratique des mesures du pH, et souligne les avantages que l'on peut en retirer en agronomie et dans les différentes branches de l'industrie parmi lesquelles : textiles, cuirs, papier, matières colorantes, sucre, confiserie, boulangerie, brasserie, distillerie, conserves et industries agricoles.

Essentiellement rédigé à l'usage des praticiens, cet ouvrage traite les exemples choisis de façon aussi complète que possible, pour que le lecteur même non initié puisse en dégager tout l'enseignement qu'ils contiennent."

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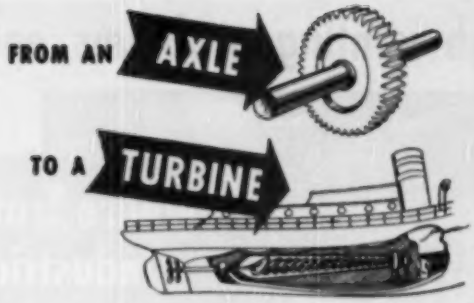
SYNTHETISCHE METHODEN DER ORGANISC EN CHEMIE, 3. Band. By W. Theilheimer. S. Karger A. G. Verlag, Basel & New York. 1949. 412 pages. 40 francs (Swiss).

Reviewed by Edgar A. Steck

The careful work of which Dr. Theilheimer has excellent reason to be proud has continued. This is the third volume of a well-organized series on current preparative methods in organic chemistry. It has a tempo suited to the needs of the research worker. The previous volumes have proven their worth, and this one is certain to do as well.

Some may be disappointed that the third and fourth volumes of the compendium will not be translated into English. However, the system of the presentation is sufficiently clear in arrangement that the users of the set will find no difficulty, even being given an English key to the index so their memory will not be overtaxed. The greater portion of the 1946-1947 literature covered in this volume is from American and British sources, and the readily-located references

(*Continued*)



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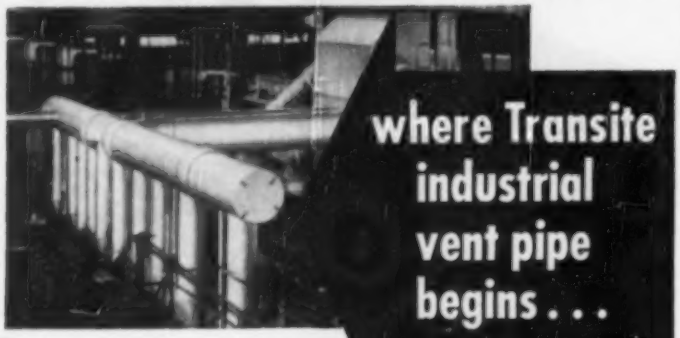
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should then be an easy reward for the user of the excellent compilation.

The essential lack of errors is a great tribute to the author. It is only in the perpetuation of the use of two systems for acridine nomenclature (probably necessary for the cumulative index to Vols. I-III) that one finds cause for chiding. The publisher would have done well to give the volume a darker binding, for it will be certain to be marred during the frequent handling by active chemists.

Dr. Theilheimer has been aided further in his work through the generosity of a number of firms and universities. The value of such gestures should be apparent to all who use the series.

Vol. III

PETROLEUM PRODUCTION ENGINEERING ECONOMICS. By Lester Charles Uren. McGraw-Hill Book Co., New York. 639 pages. $7.50

Reviewed by George H. Fancher

The dean of petroleum engineering teachers has scored again with the third volume of his triology on Petroleum Production Engineering which rounds out the impressive contribution to the petroleum industry which he began over 25 years ago. At that time petroleum engineering was scarcely formulated, and the book of Prof. Uren on the development of oil and gas fields at once became a standard text for the profession which set the pattern for the training of petroleum engineers throughout the country.

The criticism most frequently heard in the petroleum industry is that the young engineer should be better trained in English, particularly with respect to exposition, and also should be more versed in economics, i.e., more appreciative of the fact that producing oil and gas is a business. This book should aid in the solution to the latter part of the problem and should also inspire by example the student and reader to do something about the former, because Prof. Uren is a master of lucid, clear-cut and elegant exposition, and this volume is a good example of his work.

The book contains 12 chapters, a preface and both author and subject indexes. Well chosen references relative to the subject matter are placed in a short bibliography at the end of each chapter. The first three chapters provide factual background information, especially useful to those not so familiar with the petroleum industry through experience as a student,

employee, or employer. The Chapters 4-7 inclusive lay the economic background, and Chapters 8-11 inclusive discuss the major economic problems. These chapters could be improved by examples of problems worked out, despite the fact that each contains many tabulated data which facilitate problem solution. The average reader and student of a technical book wants to be told "how" as well as "what" and "why." Chapter 12 briefly discusses conservation of oil and gas reservoirs, including some facts and ideas on substitutes for petroleum. The statement (p. 572) that "an outstanding example of successful proration by voluntary cooperation among producers is found in California" no doubt was written prior to the comparatively recent decision of the California courts that the agreement on which voluntary cooperation in that state was based is illegal, null and void.

The book is well illustrated, printed on good stock, and well organized for study and should enjoy wide use as a text. Many executives, petroleum engineers and geologists will find it a useful addition to their technical libraries.

Heat Transfer & Thermodynamics

ELEMENTS OF THERMODYNAMICS AND HEAT TRANSFER. By Edward F. Obert. McGraw-Hill Book Co. 372 pages. $4.50.

Reviewed by Henry Eckhardt

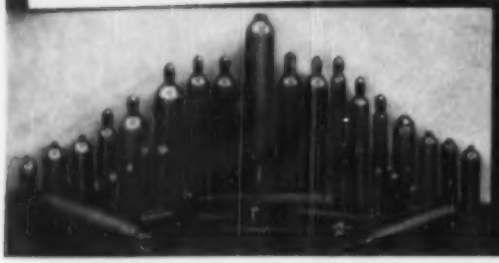
A recent issue of *The New Yorker* recounts how a six-year-old boy who had just proudly learned to count to the hundreds, was moved to silent tears when he learned that there was no "very, very last number." Obviously, there also is no end to the publication of thermodynamic text books. This last observation, alarming as it may seem to some persons, should evoke no tears from anyone. Happily for the student, Professor Obert's book might well be subtitled: "Thermodynamics Without Tears."

In detailed criticism at the outset, it is well to mention the special features which distinguish this book from among others of its kind. The first chapter is properly devoted to a survey of dimensions and units, rather than having this subject relegated to the appendix. Similarly, the notations for thermodynamics are summarized after the table of contents. Quite properly, a separate compilation of notation for heat transfer is located at the back of the book, directly after the chapter on heat transfer. Statements of laws and

(*Continued*)



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definitions are set off from the body of the text by line spacing and the use of bold face type, an aid which will be appreciated by the student as well as the engineer referring to it as a refresher.

The first law is stated succinctly, and a clear exposition of the fundamental concepts of thermodynamics is systematically presented, which leads up to the formulation of the second law. The Carnot cycle is discussed adequately and competently, and a most concise exposition of the thermodynamic temperature scale is given.

In the chapter on the second law, reference is made to three famous scientists in the history of the development of the science of thermodynamics, but in anachronological order—Planck, Clausius, and Carnot. The reviewer feels that this departure from conventional thermodynamic texts was not justified; moreover, opening the chapter with Planck's statement of the second law is not the happiest approach for the student, because it requires extra efforts of ratiocination to comprehend the meaning of the double negative it contains. In fact, this deficiency appears to be recognized, since Planck's statement is immediately paraphrased. It is only fair to state that Prof. Obert also gives the famous statement of Clausius, which is both concise and easy of comprehension.

No historical reference is made to Carnot, and only at the conclusion of the chapter will it be clear to the student that the Carnot cycle is named after a person. To the reviewer, it seems unfortunate that in an elementary textbook such as this, no reference is made to the historical development of the science, nor to Sadi Carnot, who in 1824, by pure reason, made one of the most important contributions to science. Possibly such references were omitted due to lack of space; however, as Karl Pearson stated long ago, only those familiar with the historical development of a science can hope to acquire a command of it.

Lack of space here forbids a detailed discussion of the subsequent pages of the book which comprise its *raison d'etre*, particularly because the treatment of the subject is so thorough that the quantity of information it contains belies its few pages.

The balance of the book comprises subject matter indicated by the following chapter headings: Properties of Fluids; Characteristics of Gases; Approximate Calculations for Real Gases; Flow of Fluids; Mixtures of Gases and Vapors; Thermochemical Calculations; Power Cycles—Vapor;

Power Cycles—Gas; Refrigeration; Heat Transfer. In addition to examples contained in the text, there is a total of 430 problems for solution distributed throughout the volume. The appendix comprises 12 tables of conversion constants and physical data, together with seven chart inserts, which include, of course, the Mollier diagram for steam, and a psychrometric chart for air.

Of the above chapters, the reviewer has the highest praises for the chapter on the flow of fluids, which subject is treated adequately in only 36 pages. The section on power cycles is also very good. By frequent use of examples, curves, and the deadly printer's parallel, Prof. Obert covers these sections most admirably. The up-to-dateness of this book is evidenced by the inclusion of the gas turbine process. The chapter on heat transfer is well-written in less than 50 pages. Of particular interest is the inclusion of some recent results of Farber and Scorah, which will make the student aware of the practical limitations to the maximum useful heat flux.

As to minor details, there are, of course, the inevitable typographical errors; however, none should cause anyone any trouble. Other typographical make-up may give the student more trouble. In the equations number (7-5), "R" apparently denotes both the gas constant and the Rankine temperature scale. The reviewer discovered that there was a minute difference between the two "R's"; the gas constant was set in italic type. Surely it would seem in order to have more contrast here, perhaps by the employment of the bold face "**R**," as has been done in earlier thermodynamic treatises.

Equation (12-3), which first appears on p. 214, gives the illusion of being dimensionally inconsistent, due to spacing between the characters in the denominator, to wit: "$\Sigma + W$," which appears to denote an algebraic addition. Actually, since the letter "Σ" denotes an operation, in accordance with strict mathematical convention, it would be better to set the symbols together without spacing, thusly: "$\Sigma+W$."

This review may be summed up conveniently by quoting from the author's preface:

". . . The text stresses real machines, flow process, properties of fluids, and the conditions where simplified analyses can be applied. The flow of fluids has been emphasized because the problem of fluid flow is one of the more usual tasks that the practicing engineer is called upon to treat. For the same reason, the allied subject of

(*Continued*)



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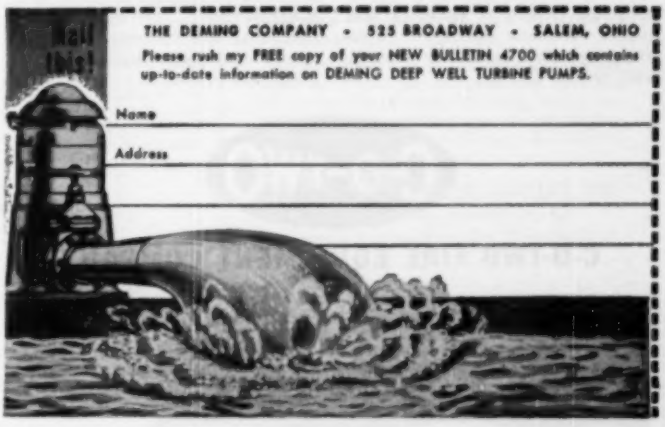
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heat transfer is introduced and surveyed in the final chapter of the text.

"This book has been written to serve the undergraduate course in thermodynamics and heat transfer for students of engineering. It is believed that the presentation has been made simple and direct without sacrificing rigor or the emphasis on the fundamental aspects and continuity of the science. . . ."

The critic must always have the last word. In this case: "Well done, Prof. Obert!"

RECENT BOOKS & PAMPHLETS

Transactions. "Transactions of the Electrochemical Society, 1949." 377 pages. $7. Vol. 95, Electrochemical Society, 235 West 102nd St., New York 25, N. Y.

Coal. "Chemical Utilization of the Subbituminous Coals of Washington." Survey has been liberally illustrated with flow charts, graphs, equipment drawings. By L. A. Conradi. 83 pages. Gratis. Report No. 6, Engineering Experiment Station, University of Washington, Seattle 5, Wash.

Valve Outlets. "American Standard Compressed Gas Cylinder Outlet and Inlet Connections." Detailed dimensions for all elements of valve outlets of compressed gas cylinders and their connections. $1.50. B57.1-1950, American Standards Association, 70 East 45th St., New York 17, N. Y.

Pharmaceuticals. "The Pharmaceutical Industry in Germany during the period 1939-1945." Includes reports on antibiotics, barbituates, insecticides, vitamins. By J. R. M. Coppock. 120 pages. 3s. 6d. British Intelligence Objectives Sub-Committee Surveys Report No. 24, H. M. Stationery Office, York House, Kingsway, London, W.C.2, England.

Phosphate Tailing. "Ultrasonic Coagulation of Phosphate Tailing." Summary and evaluation of a year's experimental work. By Dudley Thompson. 75 cents. Bulletin 75, Engineering Experiment Station, Virginia Polytechnic Institute, Blacksburg, Va.

Finishes for Aluminum. Applying surface finishes to aluminum; characteristics of finishes so produced. Information on cleaning treatments, mechanical, chemically produced, electrolytic oxide, and organic finishes, controls and tests. 124 pages. Reynolds Metals Co., 2500 South Third St., Louisville, Ky.

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Fuels. "Questions and Answers on Propane and Butane Fuels." A pocket size booklet for use with technicians and operating personnel. By J. F. Barkley. 15 cents. Bureau of Mines Question and

Answer Handbook 4. Superintendent of Documents, Washington 25, D. C.

Education. "Cooperative Engineering Education." Reports a survey made to determine the content of engineering curricula which are planned for alternate periods of campus work and of related employment in industry. By Henry H. Armsby. 25 cents. Office of Education Bulletin No. 15 of 1949, Superintendent of Documents, Washington 25, D. C.

Labor. "Techniques of Preparing Major BLS Statistical Series." How the Bureau of Labor Statistics compiles its continuing series of figures dealing with industrial employment, labor turnover, wages, industrial safety. 40 cents. Bureau of Labor Statistics Bulletin No. 992, Superintendent of Documents, Washington 25, D. C.

Natural Gas. "Possible Effect of the Expanding Use of Natural Gas on the Production of Coke and Coal Chemicals in the United States." Forecast of the effect on coal chemicals of the substitution of natural gas for byproduct gas in public utility systems. By J. A. DeCarlo and J. A. Corgan. Bureau of Mines Information Circular 7579, Superintendent of Documents, Washington 25, D. C.

Annual Report. "Annual Report 1949 of National Bureau of Standards." Summary of scientific investigations carried on at the bureau during the fiscal year 1949. 75 cents. National Bureau of Standards Miscellaneous Publication 198, Superintendent of Documents, Washington 25, D. C.

Labor. "Collective Bargaining Provisions —Hours of Work, Overtime Pay, Shift Operations." One of the series presenting typical collective bargaining agreements. 30 cents. Bureau of Labor Statistics Bulletin 908-18, Superintendent of Documents, Washington 25, D. C.

Soybeans. "Marketing Study of the Oil Content of Soybeans as Related to Production Areas and Climate." Preliminary report on the first phase of an oilseed marketing research project giving an analysis of the available data regarding the oil content of soybeans in various areas. By N. Pahigian. Production and Marketing Administration unnumbered mimeograph. Superintendent of Documents, Washington 25, D. C.

Alkyl-Titanates. "A Review of Developments of Alkyl-Titanates." Formation of alkyl-titanates, organic titanates especially butyl-titanate, methods of preparation, use of alkyl-titanates in the textile field and as paint vehicles, modified products, effects on oils. By Max Kronstein. 8 pages. 15 cents. New York University College of Engineering, c/o V. W. Palen, Bureau of Public Information, New York 53, N. Y.

German Industry. "The German Coal Tar and Benzole Industries During the Period 1938-1945." Descriptions are liberally sprinkled with detailed sketches, flow charts, tables, curves. By A. L. Deadman and G. H. Fuidge. 182 pages. 5s. 6d. British Intelligence Objectives Sub-Committee Surveys Report No. 25, Board of Trade, Lacon House, Theobalds Rd., London, W. C. 1, England.

Peanuts. "An Abstract Bibliography on Peanuts." Nearly 600 references covering the period from 1830-1939. Arranged alphabetically by author. By Nelle J. Morris and F. G. Dollear. 231 pages. Gratis. Southern Regional Research Laboratory, 2100 Robert E. Lee Blvd., New Orleans 19, La.

Colorimetry. Describes the color standards and measurement methods developed by the Bureau of Standards, giving the basis for each technique and showing how one method supplements the other. By Deane B. Judd. 30 cents. National Bureau of Standards Circular 478, Superintendent of Documents, Washington 25, D. C.

Wood. "Chemical Utilization of Wood: Utilization of Wood Waste and Bark." By Alfred J. Stamm. No. R1770. Forest Products Laboratory, Madison 5, Wis.

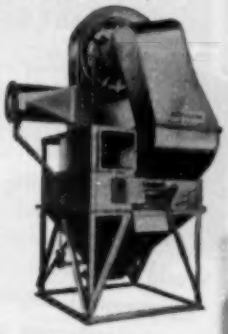
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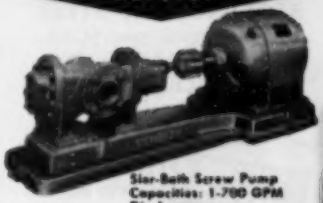
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SUBJECT	FEATURES	COMPANY
Instruments 316A	Armored meters for high pressure fluid flow rate and automatic flow control. Photographs, labeled sketches, phantom drawings show construction features. Dimension tables, capacity guide, nomograph for sizing meters in steam service. 16 pages.	Fischer & Porter Co.
Mills and Mixers 316B	Roller and colloid mills; mixer which sweeps sides and bottom of the tank and folds over the contents from side to center. Photographs, engineering drawings, specifications. 8 pages.	Troy Engine & Machine Co.
Chemicals 316C	Lists specifications, properties, solubility, packing and shipping classifications for 136 industrial chemicals. Spiral bound. 94 pages.	Dow Chemical Co.
Centrifugals 316D	Three types for handling the various kinds of mixtures. How each works is explained by diagram and several photographic views. 12 pages.	Baker Perkins Inc.
Chemicals 316E	Properties, characteristics, uses and handling information for 1,4-butanediol, an addition to the glycol series now available from this company in pilot plant quantities. Includes a chart of potential reactions. 8 pages.	General Aniline & Film Corp.
Instruments 316F	Pilot operated pressure and temperature regulators. Cutaway drawings with color key demonstrate operating cycle. Photographs, charts and tables cover main valves, controls and strainers, capacity and flow data, dimensions and weights. 32 pages.	Spence Engineering Co.
Process Equipment 316G	Outlines a line of equipment for byproduct recovery, processing chemicals, pharmaceuticals, food products. Installation photographs show applications of various types of evaporators and dryers. 28 pages.	Blaw-Knox Co.
Boosters 316H	Fluid pressure boosters and accumulators. When to use them, how to select and install them. Circuit diagrams, photographs of various models, mounting and dimensional data. 12 pages.	Miller Motor Co.
Instruments 316I	Handling of caustic soda with variable area meters. Advantages of buying high-concentration caustic and diluting immediately during unloading. Special meter design, piping arrangements, dilution calculations and pump layout. Numerous diagrams. 6 pages.	Fischer & Porter Co.
Traps 316J	Ball float traps for venting air from any liquid under pressure. Applications, hookup diagrams, cross-sectional drawing. 2 pages.	Armstrong Machine Works
Float Boxes 316K	Diagrams, descriptions and prices of line of float boxes—with pilot valve, switch, control valve etc. Also covers float and lever tank units. 6 pages.	Davis Regulator Co.
Chemicals 316L	Uses and specifications of cellulose esters; compatibility with solvents, resins and plasticizers, and procedures of analysis. Primarily a laboratory manual for those interested in applications such as textile and paper coatings, lacquers, molding compositions, paint and lacquer removers. Ninth edition. 59 pages.	Tennessee Eastman Corp.
Mixers 316M	Portable power mixers, agitator-mixer assemblies and drive, outside-packed, side-entering agitators, acid-resistant linings for mixer and other processing tanks and equipment. Photograph, specifications diagram and table for each piece of equipment. 32 pages.	Patterson Foundry & Machine Co.
Speed Reducers 316N	Four bulletins. One covers sleeve bearing, parallel shaft speed reducers. Gives tabular data on method of selection, horsepower rating, torque capacity, dimensions, flexible couplings. Another contains similar information on parallel shaft, roller bearing speed reducers. The third bulletin covers horizontal right angle speed reducers, and the fourth, vertical right angle speed reducers. Each has 24 pages.	Falk Corp.
Feeders 316P	Devoted to three sizes for handling dry materials covering a chemical feeding range from 1 to 5,000 lb. per hr. Photographs, diagrams showing typical arrangements and installations, dimension tables. 12 pages.	Omega Machine Co.
Ethylene Oxide 316Q	Methods of handling and emptying the new insulated 55-gal. drums. Construction details of drums and of high pressure, insulated tank cars are illustrated. Physical properties, toxicity, explosibility limits, specifications, safety precautions. 16 pages.	Union Carbide and Carbon Corp.
Water Conditioning 316R	Chart gives specific uses and properties of a line of chemicals to combat scale, corrosion and algae in water-using equipment. Describes this company's facilities for analysing specific plant problems. 12 pages.	Aquatrol Inc.
Fans 316S	Capacity tables for a line adapted to such applications as dust or smoke and fume exhaust systems, recirculating systems for heat treating furnaces, annealing ovens etc. Photographs show standard and special construction and the belted or direct connected arrangements which are available. 16 pages.	Robinson Ventilating Co.
Water Treatment 316T	Table shows variation in chemical composition of water supplies in various locations. Types of treatment for preventing scale formation, corrosion, foaming and em-	Elgin Softener Corp.

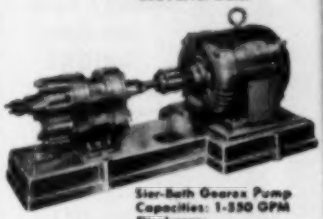
	brittlement in boilers; corrosion in steam and condensate lines; turbines and auxiliaries. Supplementary treatments for lime-soda softened, zeolite softened, and deionized water. 12 pages.	
Thermocouples 317A	Photographs and specifications for thermocouples, thermocouple wires, protecting tubes, lead wires, insulators. 16 pages.	Arklay S. Richards Co.
Resin Modifier 317B	Properties of a thermoplastic resin, how it can be used in the formulations of Buna N cements and adhesives. Properties of various resulting products. 12 pages.	Hercules Powder Co.
Pumps 317C	Index of centrifugal pumps. Units covered include close-coupled, pedestal, double suction single stage, multi-stage, self-priming, fractional horsepower, axial and mixed flow pumps. Head capacity charts and tables, data on sizes, capacities and construction features. 16 pages.	Allis-Chalmers Mfg. Co.
Materials Handling 317D	Sections on gravity conveyors, wheel and roller-type in steel and light-weight aluminum; powered conveyors; hand and platform trucks. Application tips, construction features, specification charts. 24 pages.	Rapids-Standard Co.
Valves 317E	Construction features of a line of diaphragm control valves are shown by cutaway drawings. Valve bodies have flow passages with a minimum average area of 140 percent of comparable size pipe area; inner valve open free areas average 80 percent of pipe area. 4 pages.	Kinley & Mueller Inc.
Pulp Bleaching 317F	Cold steep bleaching of wood pulp, carried out at high densities. Equipment, chemicals and methods used for treatment of groundwoods, unbleached sulphites, neutral sulphites, semi-chemicals, and krafts. Table of brightness responses shows results on a variety of typical pulps. Drawings show examples of equipment and application of the process. 16 pages.	Buffalo Electro-Chemical Co.
Fan Systems	Multiple sealed circular slide rule which provides answers to dust-sizing problems in the design of fan systems. Any known factor is set to coincide with the known cfm.; all other factors may be read with this single setting. Recommended and maximum dust velocities for all general installations appear on the reverse side. Cost is $1; requests must be made to the company.	Trane Co. La Crosse, Wis.
Pressure Blower 317G	Full-page engineering drawings show various arrangements for the line. Performance charts, photographs, materials of construction. 32 pages.	Moore Co.
Alloy Castings 317H	Centrifugal and static castings, both large and small. Photographs. Tables and charts show mechanical and physical characteristics of alloys. 16 pages.	Michiana Products Corp.
Valves 317I	Solenoid valves, including those for steam, air, gas, water and oil; for air, water and oil; for low pressure liquids and gases; for high pressure liquids and gases; for liquids. Diagrams, descriptions, prices. 8 pages.	Davis Regulator Co.
Separators 317J	Photographs show use and operation of drum type magnetic separators. Tables give capacities, weights and dimensions. 4 pages.	Magnetic Engineering & Mfg. Co.
Conveyor 317K	Heavy duty portable conveyor. Lists fields of use and products handled. Series of sketches show applications. Accessories such as feeders, screens, hoppers, are pictured and possible usage described. 8 pages.	Barber-Greene Co.
Process Equipment 317L	Lists this company's products according to application and alphabetically, together with numbered descriptive bulletin pertaining to each product. 4 pages.	Schutte and Koerting
Dehydrators 317M	Photographs and specifications for units for applications requiring clean dry air in low volume supplied automatically, continuously and at lowest dewpoints. 4 pages.	Communication Products Co.
Solvents 317N	Performance studies of two solvents in nitrocellulose formulations. Use of one solvent is compared with use of ethyl acetate or methyl ethyl ketone; the other solvent is compared with normal butanol. 4 pages.	Celanese Corp. of America.
Resin Emulsions 317P	Properties of various emulsions when used for natural rubber or Neoprene latices or adhesives for leather, paper, fabric, cellulose acetate. 3 pages.	American Resinous Chemicals Corp.
Sodium Dispersions 317Q	Two bulletins. One covers applications, preparation, procedure for handling. 11 pages. The other covers plant preparation including an equipment list and a description of apparatus. 11 pages.	National Distillers Chemical Corp.
Valves 317R	Solenoid valves. Dimension and application sketches. Includes a water flow chart, air and gas flow chart and steam flow chart for standard full area valves. Photograph and specifications chart for each type valve. 72 pages.	Automatic Switch Co.
Wires 317S	Results of tests for heat, ozone and water resistance of a type of rubber-insulated wires and cables. 4 pages.	Simplex Wire & Cable Co.
Pumps 317T	Large cutaway drawing shows design and construction features of a close-coupled pump and motor. Pumps are available from 10 to 500 gpm, at heads to 220 ft. Motors are rated from ¾ to 10 hp. 6 pages.	Allis-Chalmers Mfg. Co.
Strippers 317U	For removal of synthetic organic coatings from metals including lacquers, enamels and varnishes. 4 pages.	Enthone, Inc.
Corrosion Resistance 317V	Describes the corrosive effect of water on different kinds of brass pipe and on copper tubing and procedure that can be used to minimize the damage. 2 pages.	Water Service Laboratories
Welding 317W	Fundamentals of metal-arc transfer in inert-gas-shielded arc welding. Methods of overcoming porosity in aluminum welding by automatic and manual welding as well as stainless steel, heat-resisting alloys, clad materials and aluminum bronze. Specific applications. Photographs and charts. 26 pages.	Air Reduction Sales Co.

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Capacities: 1-700 GPM
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New Technical Literature, cont. . .

Metallizing 318A	Photographs show types of equipment that may be repaired or protected by resurfacing or refinishing with zinc, aluminum or tin. 4 pages.	Metalweld Inc.
Copper Ores 318B	Current flotation reagent practice. A variety of ores are covered in 18 examples. 8 pages.	American Cyanamid Co.
Instruments 318C	Methods for measurement of useful power with a check on reactive power to prevent overloading of generators. Schematic diagrams. 4 pages.	Minneapolis-Honeywell Regulator Co.
Fire Safety 318D	Types of fires and methods of extinguishing them are classified and explained. 4 pages.	Ansul Chemical Co.
Antioxidants 318E	Gasoline antioxidants, their use and application for improving gasoline storage stability. Flow charts show methods of antioxidant addition. Nomograph for converting antioxidant concentrations. 24 pages.	E. I. du Pont de Nemours & Co.
Filter Paper 318F	Chart gives physical characteristics of a line of filter papers for laboratory and industrial use. 4 pages.	Eaton-Dikeman Co.
Tubing 318G	Photographs and diagrams showing comparisons between this company's spun end process and other methods of fabricating various types of metal tubing. 28 pages.	Wolverine Tube Division
Water Treatment 318H	Sodium aluminate treatment of industrial and municipal water supplies. Its reaction as a softener and clarifier. Treatment of boiler feed water and internal boiler water treatment. Preparation of sodium aluminate solutions.	Monsanto Chemical Co.
Hammer Mills 318I	Actual size hammer chart for checking accurate hammer size and balance.	J. B. Sedberry Co.
Hydraulic Oils 318J	Recommended applications for each member of line. Chart shows useful life characteristics in relation to time and temperature. Case histories with photographs of actual operations. 8 pages.	Sun Oil Co.
Instruments 318K	Air-operated controllers for temperature, pressure flow, liquid level. Photographs show parts. 4 pages.	Bristol Co.
Felt Parts 318L	Samples of precision-cut felt attached to flyer illustrating applications. 1 page.	American Felt Co.
Chemicals 318M	Application for and nature of chemical maintenance products. Chart shows individual maintenance cleaning operations peculiar to division plant and equipment maintenance and provides reference material for selection of proper cleaning agents. 4 pages.	Fine Organics, Inc.
Steam Generator 318N	Pictures and diagrams illustrate the method of gas flow through the unit, soot blower arrangement, furnace and boiler wall construction and the packaged control cabinet. Capacities, dimensions, shipping weights. 12 pages.	Babcock & Wilcox Co.

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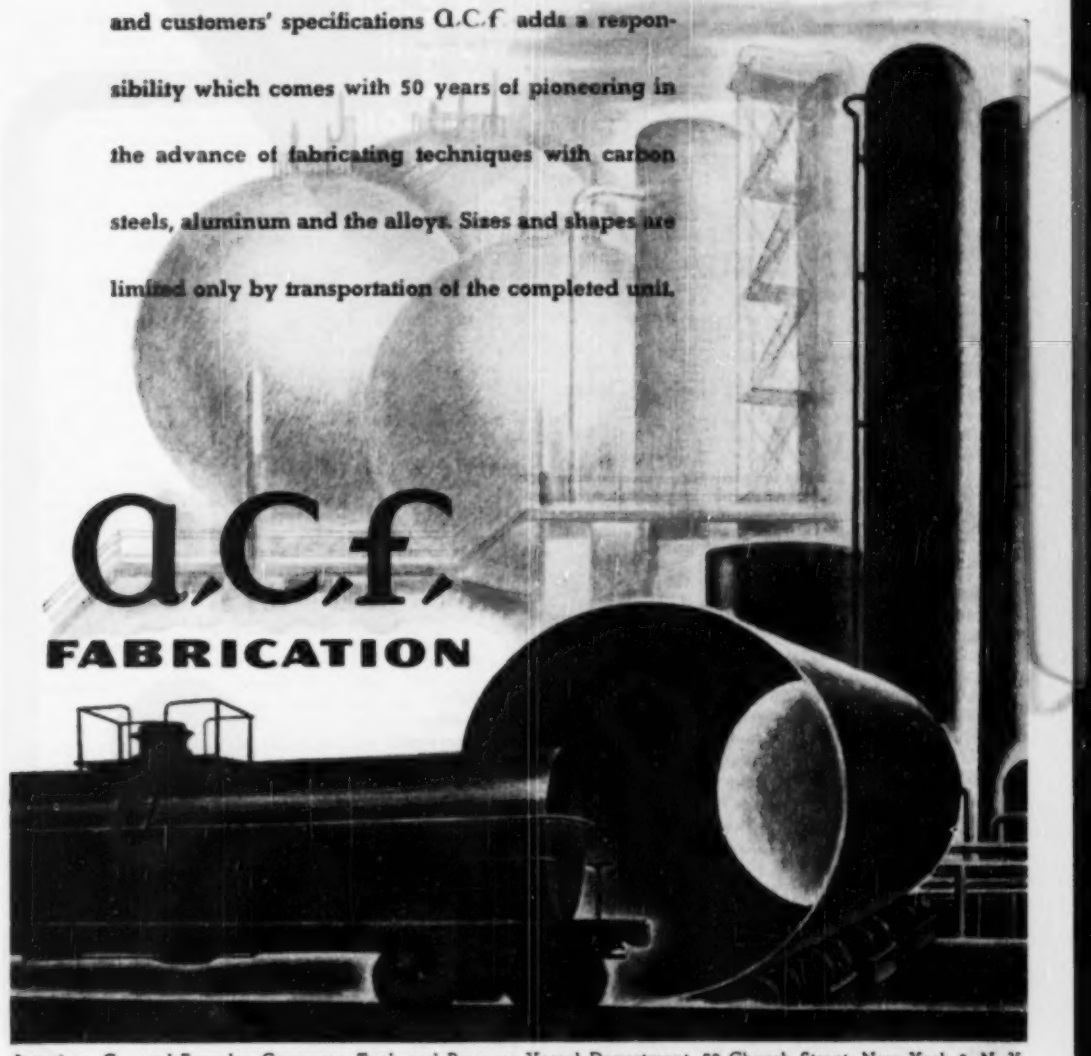
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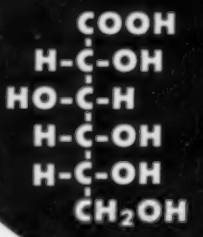


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Chemical Economics

RICHARD F. WARREN, Market Editor

Shortages Continue to Retard Output As Bigger Capacities Are Planned

Since June, most of the chemical process industries have been pushing production schedules to keep up with demand. Plans for capital expansion in this fast growing segment of U. S. Industry have enlarged tremendously. Most recent estimates indicate that the capital spending rate for 1950 may reach 2.8 billion dollars. This growth is expected to continue at the rate of 3 billion dollars or more for the next several years of world rearmament.

The chemical process industries promise to grow spectacularly in the next ten years. Their production trend is still shooting upward as new discoveries continue to broaden the range of chemical products. Chemical production as measured by the Federal Reserve Board index may well gain 70 percent. In an economy with high labor costs, the chemical processing plants will be called on to provide more and more of our national output. Each plant converts relatively cheap raw materials such as coal, crude oil, or natural gas into useful products with a low labor cost per unit. Therefore the chemical process product usually replaces articles with a high labor content.

Supply & Demand

- **Prices climbed again last month. Both chemicals and fats & oils rose sharply—see next page.**
- **Sulphur price hike to $22 per ton was reflected in higher sulphuric acid prices. Both are tight.**
- **Cuts in rubber consumption for November and December hit hard as stockpiles are built up.**
- **Pressure on producing units eased in October as new orders dipped from September levels.**
- **Priority orders have not had a big impact on industry yet. But some are here and more are coming.**

Shortages—The supply-demand picture remained confused as some chemicals remained in short supply. Benzene, alcohol, glycerine, chlorine were still tight. However, in the case of some alkalis there was a definite easing of the critical shortages. While ash and caustic remained on the hard-to-get list, the resale market sagged noticeably as consumers began to receive shipments from prime producers.

New shortages have been appearing as the CPI continued to run at record rates. For example, the tremendous pace set by sulphuric acid producers has caused some dislocation in sulphur distribution. While contracted supplies are being delivered, the transportation problem has caused a "go slow" request on orders above past needs and existing contracts. This has forced some curtailment on expanded TiO_2 operations.

Government's chemical needs—Curtailments in any form create chain reactions which move right back down to the consumers. In an effort to ease this problem the members of the chemical Market Research Association and the Commercial Chemical Development Association met with representatives of the Defense Establishment to discuss their mutual problems. (See page 219). At that meeting Col. H. M. Black, Chief of the Supply and Procurement Division in the Chemical Corps, asked chemical engineers to advise the Army on proposed specifications. Col. Black pointed out that chemical specifications are sent to prospective suppliers for comment. In many cases no criticism is received when it is invited. However, when firms are invited to bid there is criticism due to inability of firms to meet specifications. He strongly advised the chemical industry to suggest changes which might result in an item which could be procured more easily and perhaps at lower cost. Changes proposed by chemical firms are evaluated by military procurement officers against minimum requirements and often can be incorporated in the final specifications.

Another suggestion came from Dr. Warren Stubblebine. He is research director of the chemical and plastics section, Research and Development Branch, Office of the Quartermaster General. He told development men that industry should send technical and not promotion men to talk with government procurement officials. Government procurement agencies are flooded with circulars which often do not answer the technical procurement questions.

Inventories—Reports from the National Association of Purchasing Agents indicate that industrial inventories dropped substantially in October—in many cases below safe operating stocks. Slow and extended deliveries of critical materials have put many industrial consumers on a day to day basis. This is causing increasing unbalance in inventories. Expediting is a major function again in purchasing departments. Conversion to substitutes is risky since today's substitute may be tomorrow's critical item.

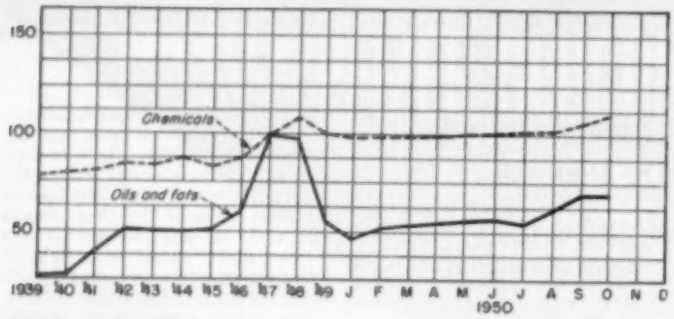
Very few firms have had to reduce or cancel orders to bring their inventories within the limits established by NPA.

Chemical Economics Handbook—Stanford Research Institute has begun publication of a Chemical Economics Handbook at Stanford, Calif. It contains graphical data sheets arranged alphabetically under the following general headings: (1) Economic indicators; (2) Major industries and commodities; (3) Chemical and allied process industries; (4) Raw Materials; (5) End chemical groups; (6) Organic chemicals; (7) Inorganic chemicals; and (8) Regional data.

From 20 to 40 data sheets are issued each month with a guaranteed annual total of not less than 250 data sheets. At the present time there are about 90 subscribers. They include firms in most of the process industries. Price is $250 per year. ($60 per year for additional subscriptions from the same organization.) The data sheets consist of data plotted on graph paper showing actual figures and a trend line.

PRICE, CONSUMPTION AND PRODUCTION TRENDS

PRICES

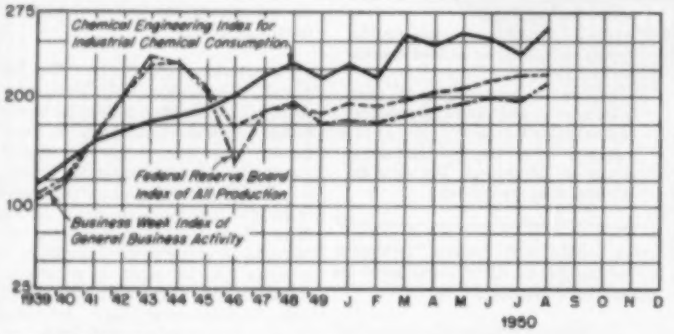


Chemical Engineering's Price Index
a month, a year, and two years ago

	Chemicals	Oils & Fats
As of November 1.	114.68	78.72
Last month	111.99	71.01
November 1949 ..	99.37	47.25
November 1948...	112.29	86.38

1947 = 100

CONSUMPTION



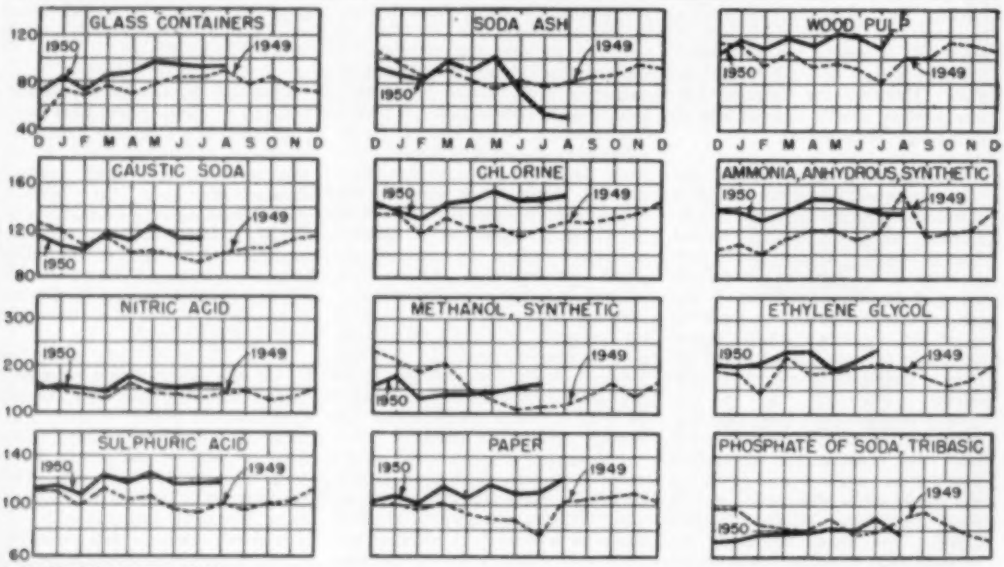
Chemical Engineering's Consumption Index for Industrial Chemicals

(A breakdown by consuming industries)

	July (Revised)	August
Fertilizers	42.50	50.95
Pulp and paper	25.50	28.70
Petroleum refining....	23.59	24.50
Glass	21.01	21.35
Paint and varnish....	27.50	30.01
Iron and steel.....	14.85	15.11
Rayon	29.55	32.41
Textiles	9.85	11.40
Coal products.....	10.93	11.02
Leather	2.30	4.00
Explosives	8.03	12.36
Rubber	5.99	6.45
Plastics	15.20	17.62
INDEX	238.79	265.88

1935 = 100

PRODUCTION



100 = Monthly Average 1947



Rolling Fabric Into Extra Profit

Take an attractive but inexpensive fabric or paper. Laminate to it a thin vinyl film. Then watch it sell like hot cakes . . . and at a premium. Essentially, that's the story behind one of America's fastest growing new product developments . . . one with wide potentialities still to be explored. Before commercial success could be achieved, machinery had to be devised for low-cost lamination and to provide fast switchover from one paper or fabric to another. Lukenweld developed 2 units, with driven jacketed stainless steel heating and cooling rolls mounted in an inexpensive welded plate frame. Today, similar machines are in wide use throughout the industry.

Maximum product dependability with minimum cost are the result of years of experience of Lukenweld engineers working with steel plate. Higher predictability, improved appearance, resistance to shock, reduced weight, increased strength and rigidity, more flexibility of machine design, reduced production costs and elimination of patterns usually result from the use of Lukenweld construction. Here at your disposal are Lukenweld's knowledge of machine design, construction, installation . . . plus Lukens 140 years' experience in developing and producing specialty steels.

If you are considering new cylinder drying machinery, processing machines or other finished units, write Lukenweld, Division of Lukens Steel Company, 400 Lukens Building, Coatesville, Pennsylvania.

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Naturally, every Bethlehem forged-steel pressure vessel is thoroughly tested before it leaves our shops—tested in accordance with the customer's pressure requirements. But the real proof is in the using—the years and years of solid, dependable service that customers get from these vessels under their own plant conditions.

Quality is never an accident, never just a happenstance, and this is doubly true in the case of Bethlehem pressure vessels. They are made of the finest carbon or alloy steels . . . forged, treated, machined to your specifications by men long trained in these particular fields. An added safety factor is the series of checks and cross-checks by watchful Bethlehem metallurgists.

We can make vessels for you in virtually any size and in a wide range of types. These can be single or multiple units, whichever you choose. If your business is high-pressure work in the chemical, rubber, petroleum, fertilizer, food-processing or kindred industries, we solicit your inquiries.

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BETHLEHEM FORGED-STEEL PRESSURE VESSELS

Commodity Survey:

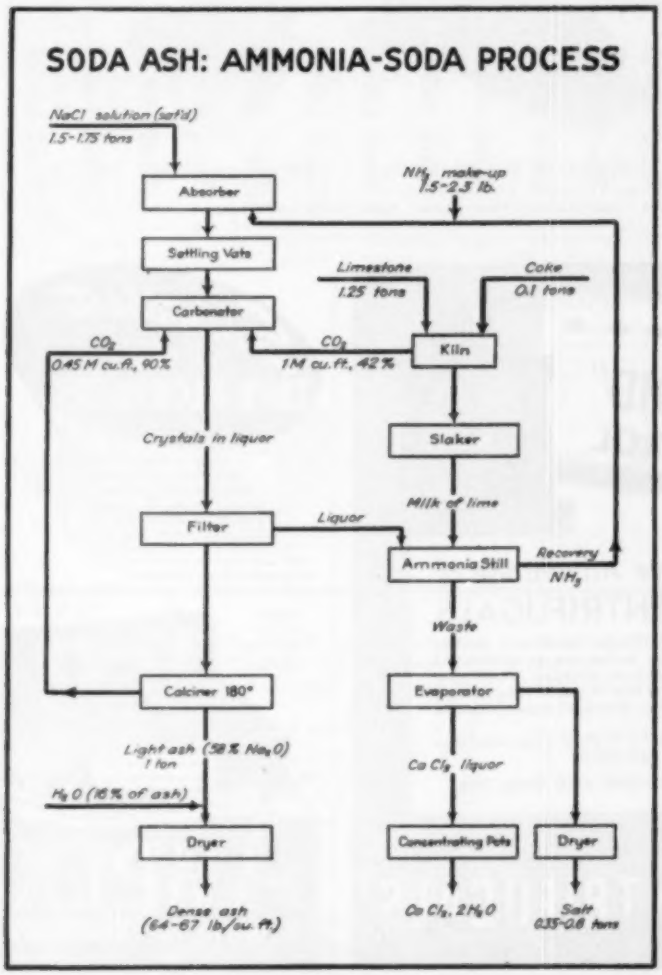
SODA ASH

King of the alkali industry, it is our third largest chemical.

JOHN R. SKEEN, *Director of Market Research, Foster D. Snell, Inc., New York, N. Y.*

Last summer District 50, UMW, and World War 2.5 combined to create a serious deficit of soda ash. Beginning June 13 and lasting for nearly four months, strikes variously affected the output of six plants. At the end, three quarters of the national capacity was involved. Actual loss in production totaled 600,000 tons. At the time all was needed to supply a war-stimulated economy initiated by the Korean hostilities. While military demands remain uncertain, the strikes are settled for a three-year period. Within a few months there may be sufficient soda ash for all.

Nearly every segment of the economy is dependent upon soda ash-textiles, soap, pulp and paper, chemicals. Recent difficulties saw the closing of several glass plants while the operation of most was threatened



Bottles became scarce and soda ash was bartered for them. The supply and distribution of caustic was disrupted and many small consumers, especially the makers of bleach, discontinued entirely. The production of bicarbonate, the chromates and silicates was reduced nearly to half.

The situation developed rapidly. Only last year most plants were operating at much less than maximum. Sales were "down badly" since mid-1948 and the decline continued with only short recoveries. Apparently the industry was slowly approaching its historically normal state, an overcapacity of more than 20 percent. Then, midnight June 12, strikes began at the three plants of Solvay Process Division. Nearly six weeks later Diamond Alkali Co. was included followed by Wyandotte Chemicals Corp. in early September. By the end of June the United States was committed to the Korean affair. During a period of rising demand, production was progressively restricted.

There wasn't much to do about it. At Baton Rouge a marooned force activated the plant in mid-July and kept it going at two thirds capacity. A few days later the Detroit plant began but at third capacity. Production of natural soda ash in California and Wyoming nearly doubled. Much was sent East by truck to sell at 6c. per lb. The world was scoured for more. About 40 thousand tons arrived from Western Europe when 10 times this amount was needed. September 1, government placed the chemical on the export control positive list. The first act of the newly created National Production Authority was to provide "a practicable minimum working inventory" control effective September 18. However, more production was the only solution.

STRIKE PROBLEMS

Several issues were responsible for the 102-day strike at the Solvay plants. For instance, District 50 wanted a pension and welfare plan patterned after that of the coal industry and restricted to union members. Management regarded this as unworkable in that it meant pediodic bankruptcy. The union also provided a strike clause which gave a 15 to 30-day notice of intention. Solvay took a "strong position" on these points.

Wyandotte resolved differences first. Settlement was reached at Syracuse September 22 and the others followed rapidly. Provisions for welfare were left to the producers and there are to be no strikes for three years. The rest provided for wage increases. Full

(Continued)

working forces returned almost immediately but maximum production was not expected until mid-October. The effects of these coincident shifts in supply and demand will be felt well into the new year. Depending upon the extent and duration of war preparations, soda ash may remain in poor supply indefinitely.

For a decade the determination of what is an adequate capacity for soda ash has been difficult. In the mid-1930's the growth rate of the industry was regarded at about 6 percent per year. At the time plants were erected at Baton Rouge, Lake Charles and Corpus Christi capable of making nearly 600,000 tons. Only half this amount was added during the war

(Continued)

Soda Ash, Ammonia Process: Producers & Annual Capacity

Unit: 1,000 short tons

	First Operation	Rated Capacity (365-Day operation)[1] 1925	1940–42 [2]	1943–46	1948–50
Solvay Process Div.[3]		800	1,735	1,936	2,136
Syracuse, N. Y.	1884		804	804	804
Detroit, Mich.	1897		730	730	930 [4]
Baton Rouge, La.	1935		201	402 [5]	402
Wyandotte Chemicals Corp.[6]		630	730	730	820 [4]
Wyandotte, S. Plant, Mich.	1883		182	182	
Wyandotte, N. Plant, Mich.	1895		548	548	[11]
Diamond Alkali Co.		350	657	727 [7]	727
Painesville, Ohio	1912				
Mathieson Chemical Corp.[8]		150	474	474	639
Saltville, Va.	1895		274	274	274
Lake Charles, La.	1935		200	200	365 [10]
Columbia Chemical Div.[9]		225	365	365	365
Barberton, Ohio	1909				
Southern Alkali Corp.[9]		0	182	218 [4]	218
Corpus Christi, Tex.	1934				
Total		2,155	4,143	4,650	4,905

[1] Capacities are approximate and unofficial. [2] Except for the Southern Alkali plant and that of Mathieson at Lake Charles, estimates agree with those of T. P. Hou, *Manufacture of Soda*, p. 40. [3] Began as Solvay Process Co., now Division of Allied Chemical & Dye Corp. [4] Began as Michigan Alkali Co. [5] Formerly Mathieson Alkali Works. [6] Established as Columbia Chemical Co., subsidiary Pittsburgh Plate Glass Co. [7] Jointly owned by American Cyanamid Co. and Pittsburgh Plate Glass Co. [8] War-time expansions completed 1943. [9] Increases completed 1948. [10] Increase probably accomplished 1947. [11] An expansion in this plant of uncertain amount; change in operations in S. Plant.

Sodium Carbonate: Chemical Engineering's Estimated Consumption

Unit: thousand short tons

	1931	1933	1935	1937	1939	1941	1942	1943	1944	1945	1946	1947	1948	1949
Caustic and bicarbonate	684	659	650	722	786	1,033	960	1,010	1,033	1,114	1,128	1,130	1,137	1,150
Glass	502	510	662	903	744	990	1,100	1,200	1,290	1,320	1,400	1,440	1,370	1,400
Chemicals	390	437	531	696	686	800	840	980	1,025	960	910	1,030	1,030	1,045
Soap (total)	186	170	170	180	200	170	165	150	162	130	120	135	127	130
Cleansers	112	94	120	140	137	70	80	85	100	110	125	130	135	135
Pulp & Paper	78	80	80	104	105	155	145	155	170	175	190	220	230	235
Water Softening	56	46	45	46	25	70	80	98	110	100	90	100	110	110
Textiles	31	34	48	38	43	60	56	58	61	68	72	71	69	70
Aluminum production	26	15	18	43	48	150	260	450	320	200	140	190	210	220
Other	231	274	185	255	197	248	248	370	421	384	310	354	435	331
Total	2,275	2,317	2,509	3,037	2,961	3,746	3,934	4,543	4,692	4,581	4,490	4,800	4,853	4,826





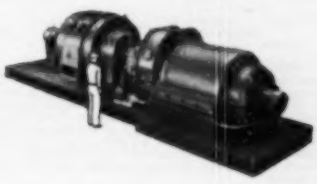
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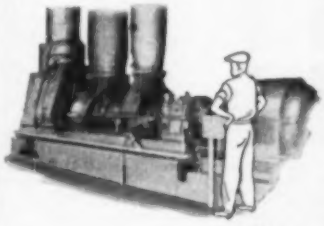
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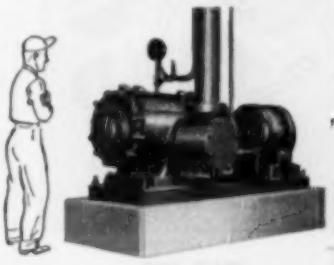


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years as the War Production Board did not find it necessary to place soda ash on allocation. Subsequently an expansion of another 600,000 tons was achieved and contributed by the natural and ammonia branches of the industry. Thus the total today is about 5.3 million tons. In comparison the domestic economy at no time consumed more than 4.7 million with normal expectancy considerably less. However, conclusions on future productive expansions and consuming markets are not possible until a method is devised for predicting the course of politics and war.

Soda Ash, Natural: Producers & Annual Capacity

Unit: 1,000 short tons

	First Soda Ash Operation		Capacity[1]				
	By Co.	At Site	1941	1942-46	1947	1948	1950
American Potash & Chemical Corp.[2] Trona, Calif.	1934	1934	53	91	91	143	145
West End Chemical Co.[3] West End, Calif.	1927	1927	60	83	83+	180	180
Permanente Metals Corp.[4] Lone Pine, Calif.	1947		0	0	27.5	27.5	27.5
Pittsburgh Plate Glass Co.[5] Bartlett, Calif.	1944	1926	10	14	14	14	14
Westvaco Chemical Div.[6] Green River, Wyo.	1947	1947	0	0	(Neg.)	10	29
Natural Soda Products Co.[7] Keeler, Calif.	1912	1885	23	33	33	33	—
Dry Lakes Chemical Corp.[8] Cartago, Calif.	1948	19	0	0	0	5	—
Total			148	223	c.290	384	365

[1] While capacities are approximate, such error as exists is due to uncertainty of memory rather than unwillingness of the industry to contribute fact. [2] First operated by John W. Searles for borax, 1862-95; present company began at site 1926. [3] Capacity increased late 1947 or early 1948 (probably both). [4] Said to be variable operation. [5] In 1926, Kuhnert Syndicate began construction; became Pacific Alkali, 1940; acquired by Pittsburgh, 1944; capacity fairly constant from 1M-1.2M tons per month. [6] Planned 25 million dollar investment for cap. of 360 M tons per year; presently making somewhat less than 30 M tons. [7] Company merged with Inyo Development Co., 1924; Inyo began at site c. 1885; acquired by Wyandotte, 1934 to supply West Coast; sold 1950 & operations will discontinue. [8] Site of California Alkali Co., subsidiary Gt. Western Electro-Chemicals Co., 1917-19; began 1948 with a token production and not now operating.

Soda Ash: Supply & Price

Unit: 1,000 short tons

	Supply[1]	Production by Source			Foreign Trade[2]		Price[3] $/100 lb.
		Total[4]	Ammonia[5]	Natural[6]	Imports	Exports	
1931	2,255	2,275	2,197	78.5	7.6	27.6	1.161
1933	2,765	2,317	2,249	68.4	6.7	28.4	
1935	2,465	2,509	2,414	96.2	0.0	43.5	1.220
1937	2,983	3,027	2,916	119.6	0.0	54.7	1.137
1939	2,883	2,961	2,826	133.9	0.0	80.1	1.060
1941	3,741	3,724	3,607	117.6	0.0	82.4	1.030
1942	3,900	3,925	3,789	136.2	0.0	64.5	1.030
1943	4,428	4,571	4,408	163.5	8.4	152.9	1.050
1944	4,648	4,718	4,538	179.6	9.4	79.3	1.050
1945	4,505	4,557	4,375	181.8	18.3	70.4	1.060
1946	4,433	4,494	4,284	209.4	5.9	67.0	1.078
1947	4,693	4,800	4,519	281.3	0.7	107.2	1.225
1948	4,665	4,872	4,575	297.5	0.0	207.1	1.350
1949	4,044	4,119	3,910	209.3	0.0	75.6	1.362
1950 1Q	1,088	1,077	1,027	50.0	0.0	0.5	1.250
2Q	1,080	1,101	1,041	60.3	0.7	15.6	1.287

[1] Total production plus imports minus exports. [2] 1931-47: Industry Report, *Chemicals & Drugs*, Oct. 1948, p. 47, "Soda Ash," F. M. Hoffheins; 1948-49: ibid., March 1950, p. 11; 1940, 1Q: ibid., June 1950, p. 13. Original data from *FT 410 & 110*. [3] Bureau Labor Statistics; 58 percent, light, el., bgs., f.o.b. works. [4] 1941-50: *Chemicals & Drugs*, ibid. [5] 1931-39: "total" less "natural", 1941- : *Chemicals & Drugs*. [6] 1931-37: "Natural Soda & Soda from Other Processes", Bureau of the Census; 1931- : *Facts for Industry*, series M19A and supplements; 1945-49: see M19A-09.

Related Chemicals: Production*

Unit: 1,000 short tons

	Bicarbonate (100%)	Caustic (100%)†		Soda Ash (98-100%)	
		Lime-Soda	Electrolytic	Light	Dense
1931	140.2	447.1	199.2		
1933	120.3	431.0	242.9		
1935	136.6	428.7	316.3		
1937	143.2	479.5	470.7		
1939	180.9	552.9	482.7		
1941	169.4	680.0	743.3		
1942	160.6	634.3	939.9		
1943	173.0	662.5	1,116.2	2,306	1,368
1944	185.2	688.6	1,182.9	2,455	1,462
1945	174.9	735.0	1,129.3	2,286	1,444
1946	189.9	742.9	1,130.6	2,080	1,547
1947	181.1	747.2	1,267.0	2,194	1,641
1948	180.9	769.7	1,587.9	2,518	1,595
1949	153.8	806.2	1,656.8	2,051	1,325
1950, 1Q	30.4	137.0	436.5	540	354
2Q	38.8	154.1	496.7	528	384

* Prime sources: *Census of Manufactures*, 1931-39; 1941- : *Facts for Industry*, series M19A and supplements and as revised in subsequent Industry Reports. † 1931-39: values corrected to 100 percent NaOH, excludes production in pulp and paper industry.

—End

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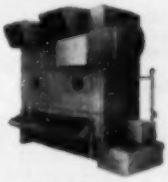
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NEW CONSTRUCTION

	Current Projects		Cumulative 1950	
	Proposed Work	Contracts	Proposed Work	Contracts
New England			$4,100,000	$1,472,000
Middle Atlantic		$1,708,000	2,510,000	31,837,000
South	$17,000,000	19,622,000	79,768,000	178,717,000
Middle West		7,773,000	11,420,000	52,006,000
West of Mississippi	11,300,000	15,968,000	108,300,000	127,294,000
Far West		3,960,000	21,236,000	15,433,000
Canada			21,938,000	30,640,000
Total	$28,300,000	$48,931,000	$249,466,000	$437,399,000

Proposed Work

Ala., Decatur—Chemstrand Corp. (Monsanto Chemical Co. and Vincose Corp., St. Louis, Mo., joint owners) plans to construct a synthetic fibre plant near here. Estimated cost $5,000,000

La., Lake Charles—Continental Oil Co., Oil & Gas Bldg., Houston, Tex., plans to double the capacity of its refinery here. Estimated cost $10,000,000

Miss., Brandon—Marquette Cement Mfg. Co., 20 North Wacker Dr., Chicago, Ill., plans to construct a cement plant here to cost several million dollars.

Tex., Alvin—Phillips Petroleum Co., City Natl. Bank Bldg., Houston, plans to construct a gasoline and recycling plant. Estimated cost $9,500,000

Tex., Denison—Conway Oil Co., Denison, plans to construct a refinery for the manufacture of edible oils. Estimated cost $1,300,000

Tex., Houston—Lubrizol Corp., N. Esperson Bldg., plans to enlarge its chemical plant. Estimated cost $500,000

Contracts Awarded

Ala., Tarrant—Alabama By-Products Corp., Tarrant, has awarded the contract for constructing battery of 29 chemical-recovery coke ovens at its plant here to Koppers Co., Inc., First Natl. Bank Bldg., Pittsburgh, Pa.

Calif., Vernon — Mallinckrodt Chemical Works, Inc., 923 East 3rd St., Los Angeles, has awarded the contract for a warehouse to Buttress & McClellan, 1900 Beverly Blvd., Los Angeles, at $140,000

Ill., Chicago—Allied Chemical & Dye Corp., Aniline Div., 3420 West 48th St., has awarded the contract for a plant to Poirot Construction Co., 2001 Pershing Rd., at $200,000.

Ill., Chicago—Allied Chemical & Dye Corp., Barrett Div., 2818 South Sacramento St., has awarded the contract for plant additions to Steelcraft Mfg. Co., 600 South Michigan Ave., at $90,000

Ill., Chicago—Berker Chemical Co., 138th St. at C. & E. I. R. R., has awarded the contract for a chemical plant to Kenwood Metal Bldgs., Inc., 1750 West 75th St., at $300,000

Ill., Chicago—E. I. du Pont de Nemours & Co., Inc., 2542 Elston Ave., has awarded the contract for a processing and warehouse building to H. N. Saunch, 165 West Wacker Dr., at $100,000

Ia., Des Moines—Firestone Tire & Rubber Co., Akron, O., has awarded the contract for an industrial plant and warehouse to National Industrial Construction Co. (affiliated with Morrison-Knudsen Co. of Los Angeles, Calif. and Boise, Idaho. Estimated cost $5,000,000

Ky., Bradenburg—Mathieson Chemical Corp., Whitaker Bldg., Baltimore, Md., has awarded the contract for design and construction of a plant for the conversion of natural gas byproducts to hydrocarbon chemicals, to E. B. Badger & Sons Co., 75 Pitts St., Boston, Mass. Total estimated cost $13,000,000. (Correction—name of contractor—September issue.)

Ky., Louisville—Louisville Refining Co., 1300 Western Pkway., has awarded the contract for an oil cracking plant to Petroleum Piping Construction Co., Hammond, Ind. Estimated cost $2,000,000

La., Chalmette—Bay Petroleum Corp., Chalmette, and Denver, Colo., has awarded the contract for modernizing and expanding its refinery to Procon, Inc., Chalmette. Estimated cost $2,750,000

La., Lake Charles—Continental Oil Black Co., Amarillo, Tex., has awarded the contract for design and construction of a carbon black plant to United Engineers & Constructors, Inc., 1401 Arch St., Philadelphia, Pa. Estimated cost $1,500,000

La., Lake Charles—Jefferson Lake Sulphur Co., c/o Freeport Sulphur Co., Freeport, Tex., has awarded the contract for additional construction at its plant here to Tellepson Construction Co., 1710 Telephone Rd., Houston Tex. Estimated cost $850,000

La., Mansfield—United Gas Pipe Line Co., 1525 Fairfield Ave., Shreveport, will construct a booster station here with own forces. Estimated cost $325,000

La., New Orleans—Ideal Cement Co., c/o A. J. MacDowell, contractor, Denver, Colo., will construct a warehouse. Estimated cost $595,000

Mich., Ferndale—Reichhold Chemicals, Inc., Woodward Heights, has awarded the contract for a chemical factory to Rudy-Sackett Co., 4181 Oakman St., Detroit. Estimated cost $1,000,000

Miss., Independence—Trunkline Gas Co., Edge, Tex., has awarded the contract for compressor stations on line to East here, also at Epps and Joppa, Ill., and Longville, La., to Tellepson Construction Co., 1710 Telephone Rd., Houston, Tex. Estimated cost $925,000

N. J., Millville—Wheaton Glass Co., 212 G St., has awarded the contract for a factory building to L. C. Bowers, 180 Nassau St., Princeton, N. J. Estimated cost will exceed $68,000

N. C., Wilmington—Robertson Chemical Corp., c/o McCloskey Co., contractor, Liberty and Denny Sts., Pittsburgh, Pa., will rebuild its plant. Estimated cost will exceed $100,000

O., Cleveland—Standard Oil Co., Midland Bldg., has awarded the contract for a crude oil distillation plant to Arthur G. McKee & Co., 2300 Chester St., Cleveland. Estimated cost $5,500,000

O., Toledo—Libbey-Owens-Ford Glass Co., Nichols Bldg., has awarded the contract for a chemical plant to Chemical Plants Div. of Blaw-Knox Co., 321 Penn Ave., Pittsburgh, Pa., $600,000

Pa., Philadelphia—E. I. du Pont de Nemours & Co., Inc., Wilmington, Del., will construct a 1 story manufacturing plant. Work will be done with separate contracts. Estimated cost $70,000

Pa., Philadelphia—Paper Manufacturing Co., 5th and Willow Sts., will construct a manufacturing plant and office. Work will be done by separate contracts. Estimated cost $1,500,000

Pa., West Point—Sharpe & Dohm, Inc., West Point, has awarded the contract for design, fabrication and installation of high vacuum drying equipment for new blood plasma processing plant to National Research Corp., 70 Memorial Dr., Cambridge, Mass.

Tenn., Cattanooga—Tennessee Paper Mills, Manufacturers Rd., has awarded the contract for plant alterations to John C. Becking, c/o owner. Estimated cost $277,000

Tenn., Memphis—E. I. du Pont de Nemours & Co. Inc., du Pont Bldg., Wilmington, Del., will construct a sodium cyanide plant on 225 acre site here with own forces. Estimated cost $7,500,000

Tex., Beaumont—Texas Gulf Sulphur Co., City Natl. Bank Bldg., Houston, has awarded contract for fabrication and erection of plant in Spindletop area to Consolidated Western Steel Corp., Box 341, Orange. Estimated cost $2,000,000

Tex., Houston—Swift Oil Mill Co., 6th and Rutland Sts., will reconstruct its oil mill. Work will be done by purchase and hire. Estimated cost $118,000

Tex., Orange—Jefferson Lake Sulphur Mining Co., Jefferson Lake, is constructing a sulphur mining plant with own forces. Estimated cost $2,500,000

Tex., Snyder—Sunray Oil Co. and Associated Operators, Philtower Bldg., Tulsa, has awarded the contract for an Isobutane and natural gasoline plant to Fluor Corp., Ltd., N. Esperson Bldg., Houston. Estimated cost $6,250,000

Wash., Bellingham—Puget Sound Pulp & Timber Co., Bellingham, has awarded the contract for an addition to its bleaching plant to Howard S. Wright & Co., 407 Yale Ave., N., Seattle, at $119,640

Wash., Spokane—Kaiser Aluminum & Chemical Corp., 924 Bway., Oakland, Calif., has awarded the contract for adition to rectifier building, carbon baking furnace building, carbon press building, etc. at Mead Reduction Works to Kaiser Engineers, Inc., 1924 Bway., Oakland. Estimated cost $3,700,000

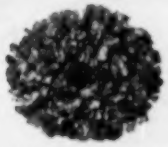
W. Va., Clarksburg—Pittsburgh Plate Glas Co., Bldg., Pittsburgh, Pa., will construct a new plant building. Work will be done by separate contracts. Estimated cost $500,000

Wis., Milwaukee—Phillips Petroleum Co., Bartlesville, Okla., has awarded the contract for two warehouses to Lippert Bros. Co., Inc., 2800 North Santa Fe St., Oklahoma City, Okla., at $83,500

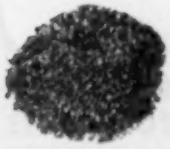
Handles HOT Insulating Material...SAFELY!



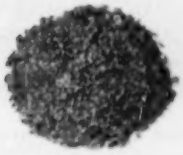
Grades Material to Exact Size!



INSULATION FILL



REFRIGERATION SIZE



PLASTER AGGREGATE

ZONOLITE BRAND vermiculite insulation is produced by Western Mineral Products Company at their Milwaukee plant.

In final production stages, this mica mineral product is heated to extremely high temperatures . . . then graded into various sizes for different applications. Use of a gyratory sifter with *wood* sieves resulted in warpage because of the excessive heat.

An Allis-Chalmers *all-metal* gyratory sifter replaced the wood model in July of 1949 and has been operating without trouble ever since. The only maintenance required, according to S. M. Howard, plant manager, has been routine lubrication of moving parts.

VERSATILE UNIT

Accurate grading of hot insulating material is just *one* of the many mineral and chemical processing jobs being handled by this versatile *Low-Head* sifter. It resists heat . . . it sifts the roughest of material . . . and it can be cleaned without harm by *washing*.

Get full details on this high-speed, high-capacity all-metal sifter from any Allis-Chalmers sales office. If more convenient, write Allis-Chalmers direct. A-3182

ALLIS-CHALMERS, 1147A SO. 70 ST
MILWAUKEE, WIS.

Low-Head is an Allis-Chalmers trademark.

ALLIS-CHALMERS

CHEMICAL MILLING AND PROCESSING EQUIPMENT



IT TAKES THE RIGHT VERSENE* TO DO THE JOB RIGHT . . . . .

The great and growing Versene family now has seven members. All of them are powerful organic complexing agents. All of them control cations in solution. All of them solve problems in metallic ion contamination . . . But only one (the *right* one) can do *your* job efficiently. This is why it's important for you to select the Versene best suited to solving your own particular problem.

VERSENES* ARE VERSATILE

So versatile are the Versenes that they can help you in almost any metallic ion contamination problem. They give exacting chemical control of troublesome cations by keeping them in soluble complex form. They are extremely efficient and amazingly stable at high temperatures and at all pH s. Investigate them now.

Send for samples and ask for Technical Bulletin No. 2. A clue to your problem will put a generation of experience in pioneering the polyamines at your command.

*Trade Mark

HOW TO CHOOSE THE RIGHT VERSENE*

VERSENE REGULAR
(the original Versene) is the sodium salt of ethylene-diamine-tetra-acetic acid. It is available in solution or dry form. It inactivates all metallic ions but is not a specific for complexing iron.

VERSENE Fe3 SPECIFIC
is the most powerful complexing agent known for iron in the normal pH range. It also chelates copper, nickel and cobalt.

VERSENE Fe3
is a combination of *Versene* and *Versene Fe3 Specific*. It complexes both iron and other metallic ions. The composition may be altered to meet individual requirements.

VERSENE T
complexes ferric and divalent metal ions *including* hard water salts in *concentrated caustic solutions.*

The other three *Versenes** are special purpose compounds for experimental, laboratory and pharmaceutical use. Technical information on request.



BERSWORTH CHEMICAL COMPANY
FRAMINGHAM, MASSACHUSETTS

Warehouse Stocks
Providence Agent: George Mann, 251 Fox Point Boulevard, Providence, Rhode Island
W. Coast Agent: Griffin Chemical Co., San Francisco, Los Angeles
Midwest Agent: Kraft Chemical Co., Inc., 917 W. 18th St., Chicago
Wasatch Chemical Co., Salt Lake City, Utah
Barada & Page, Inc., Dallas and Houston, Texas

Variety

is the spice of an American flexible connector's life!



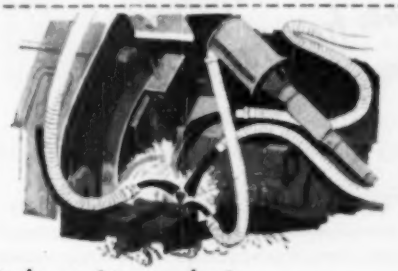
Baker's baby

Believe it or not, this machine forms rolls out of dough. Yep, it's a Readco Vacuum Roll Divider and Rounder. In goes the dough—out come the rolls, ready to bake. American Seamless Flexible Bronze Tubing carries the vacuum—which shows that this famous tubing is equally good for carrying "nothing."



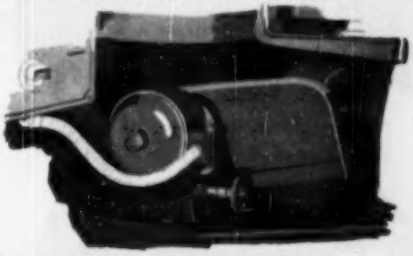
Deadly "CO" has to go

Yes, deadly carbon monoxide is carried off safely by this "Monoxivent" exhaust system, built by the Kent-Moore Organization, Inc. American VAC Type Flexible Stainless Steel Tubing, dependably tight and resistant to rust, heat and corrosion, handily connects the car exhaust to the underfloor duct.



Metal-working robot

With uncanny precision and "intelligence" this automatic lathe installed at The Black & Decker Mfg. Co. puts the bite on metal rod while this American Flexible Coolant Line carries oil to the tool edge. To remove damaging particles of metals, the cutting oils and coolants are clarified by a DeLaval Purifier.



This machine can can

Anyway, it can can as long as the motor can. In use at The California Packing Corporation, it's a disc feeder which automatically feeds cans into a fruit canning production line. The motor feed wires are safely tucked away in American Sealtite* Conduit which protects the wires while providing flexibility for belt take-up.

*Trade Mark

THERE'S a type of American Flexible Metal Hose or Tubing for conveying liquids, many chemicals, gases and semisolids under severe conditions of temperature, pressure and frequent movement . . . for protecting wiring and flexible drive shafts . . . for absorbing vibration . . . for connecting misaligned piping and ports. Let us tell you about them in full detail. The American Brass Company, American Metal Hose Branch, Waterbury 20, Connecticut. In Canada: The Canadian Fairbanks-Morse Co., Ltd.

wherever connectors must move

ANACONDA

American

FLEXIBLE METAL HOSE AND TUBING

HERE'S WHY

CMH Expansion Joints are preferred by so many piping engineers

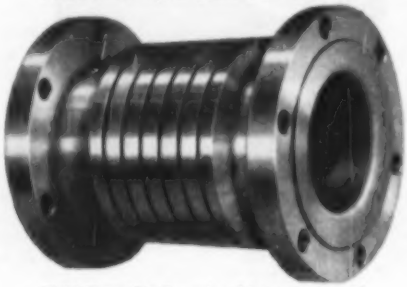
- ✓ Space Saving
- ✓ Weight Saving
- ✓ Streamlined Flow
- ✓ Lower Overall Cost
- ✓ Ease of Installation
- ✓ Trouble Free Operation
- ✓ Freedom from Maintenance



CMH Free-Flexing Expansion Joints for pressures to 30 psi; stainless steel or copper; flanges or welding ends; standard sizes to 30" I.D.; larger sizes available for special applications.



CMH Controlled Flexing Expansion Joints for pressures to 300 psi; stainless steel or copper; flanges or welding ends; sizes to 30" I.D.



CMH Flexoniflex Expansion Joints with integral control rings for pressures to 1500 psi; stainless steel and other alloys; standard sizes ⅜" through 6" I.D.; larger sizes also available.

THE PROBLEMS of pipe motion control are reduced to a minimum when you use CMH corrugated type expansion joints. Scientifically formed by advanced methods, they represent the modern, cost-saving, trouble-saving way to control axial, lateral or radial motion in piping or to correct for misalignment.

For new installations or for replacement of obsolete equipment, specify CMH expansion joints. Complete data is given in CMH'S Expansion Joint Design Guide. Write for a copy . . . it's the first step towards eliminating the headaches that are so often a part of pipe-line motion control.

Flexon identifies CMH products that have served industry for over 48 years.



CHICAGO METAL HOSE Corporation

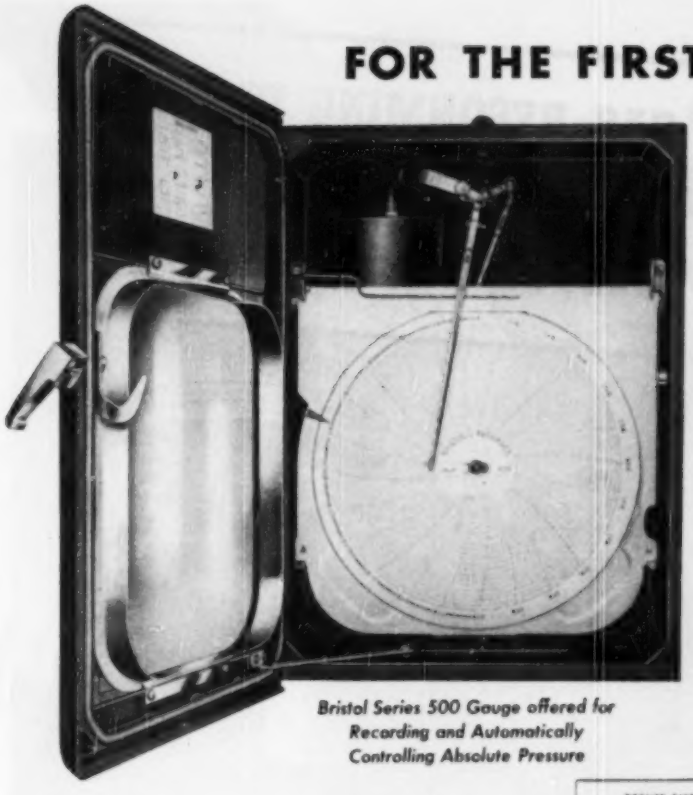
1317 S. Third Avenue • Maywood, Illinois • Plants at Maywood, Elgin and Rock Falls, Ill.
In Canada: Canadian Metal Hose Co., Ltd., Brampton, Ont.

CMH

ONE DEPENDABLE SOURCE
for every flexible metal hose requirement

Convoluted and Corrugated Flexible Metal Hose in a Variety of Metals • Expansion Joints for Piping Systems
Stainless Steel and Brass Bellows • Flexible Metal Conduit and Armor • Assemblies of These Components

FOR THE FIRST TIME



Bristol Series 500 Gauge offered for Recording and Automatically Controlling Absolute Pressure

Accurate Mechanical Recording and Controlling of Absolute Pressure

IN RANGES AS LOW AS 0 TO 6 MM!

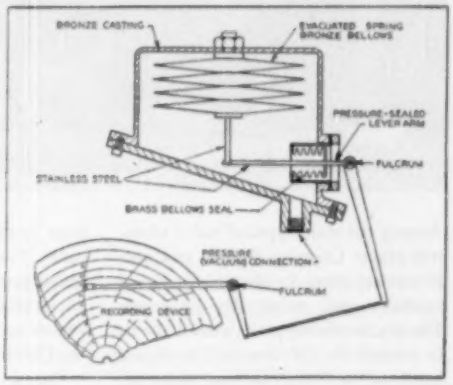
Again, Bristol scores a first!

Our new Low-Range Absolute Pressure Recording Gauge gives a direct reading of pressure above zero absolute, inherently corrected for barometric variations, with far greater accuracy than ever before possible—measuring ranges as low as 0 to 6 mm mercury absolute.

SINGLE BELLOWS—NO COMPENSATION NEEDED

Instead of *two* pressure elements—one for measured pressure, one to compensate for barometric pressure—Bristol uses a single calibrated bellows element, evacuated to practically a perfect vacuum, enclosed in a cast bronze pressure-tight housing. The bellows motion is transmitted outside the housing through an entirely new device—a pressure-sealed lever arm that is frictionless, entirely free from lost motion and turning moments due to changes in differential pressure across it.

Thus—with one measuring element, Bristol's Absolute Pressure Gauge operates in ranges hitherto considered impractical with metallic elements.



WHAT'S YOUR APPLICATION?

This entirely new, highly-accurate, direct-reading mechanical pressure instrument gives valuable information for controlling pressure wherever the operation of equipment depends upon a high and constant vaccum.

Bristol Low-Range Absolute Pressure Gauge is offered for recording, pneumatic or electric controlling, and pneumatic or electric remote transmission. For Bulletin G620, write THE BRISTOL COMPANY, 109 Bristol Road, Waterbury 91, Conn. (The Bristol Co. of Canada, Ltd., Toronto, Ont.; Bristol's Instruments Co., Ltd., Lynch Lane, Weymouth, Dorset, England.)



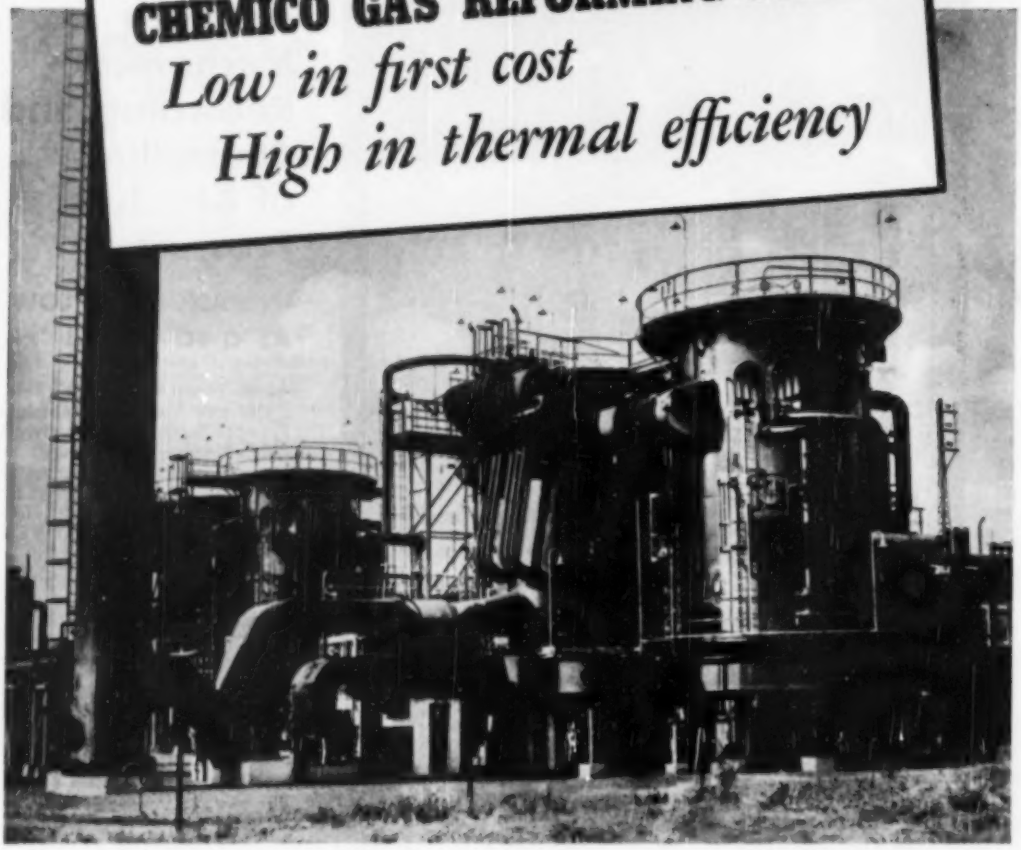
BRISTOL

Engineers Process Control for Better Products and Profits

AUTOMATIC CONTROLLING, RECORDING AND TELEMETERING INSTRUMENTS

CHEMICO GAS REFORMING PLANT

Low in first cost
High in thermal efficiency



Among the many types of heavy chemical plants Chemico designs and constructs are those for the production of synthesis gas, principally hydrogen. The gas reforming plant, shown above, is located in the synthetic ammonia works of the Office National Industriel de l'Azote at Toulouse, France. It has been operating successfully for a year and a half.

Other Chemico installations for the catalytic reforming of natural gas have been producing for as long as eight years. The total output of all these plants is more than 180,000,000 cu. ft. of reformed gas per day. Four more plants are now under construction in the United States and foreign countries.

Chemico's design provides important advantages. These plants are low in first cost, high in thermal efficiency. Construction is simple. The plant is foolproof . . . requires a minimum of operating and maintenance attention.

CHEMICO
GAS REFORMING PLANTS
are used for making:

- **Hydrogen-nitrogen mixtures for ammonia synthesis.**
- **Hydrogen and carbon monoxide mixtures for methanol synthesis.**
- **Carrier gas for blending with natural gas for distribution by Public Utilities.**
- **Hydrogen for industrial uses.**

CHEMICAL CONSTRUCTION CORPORATION

A UNIT OF AMERICAN CYANAMID COMPANY

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Chemico plants are profitable investments



We're putting a lot into Plastics!

The plastics industry may well pride itself upon the tireless research, creative imagination and aggressive promotion which have boosted plastics production 600 per cent in the last 10 years.

We at Barrett, too, take pride in our own contributions to this colorful new world of plastics. Over the years we have kept the industry supplied with a vast and growing stream of basic chemicals and plasticizers. For some of these, we are the world's principal supplier.

Helping businesses like the plastics industry to prosper has made Barrett "one of America's great basic businesses."

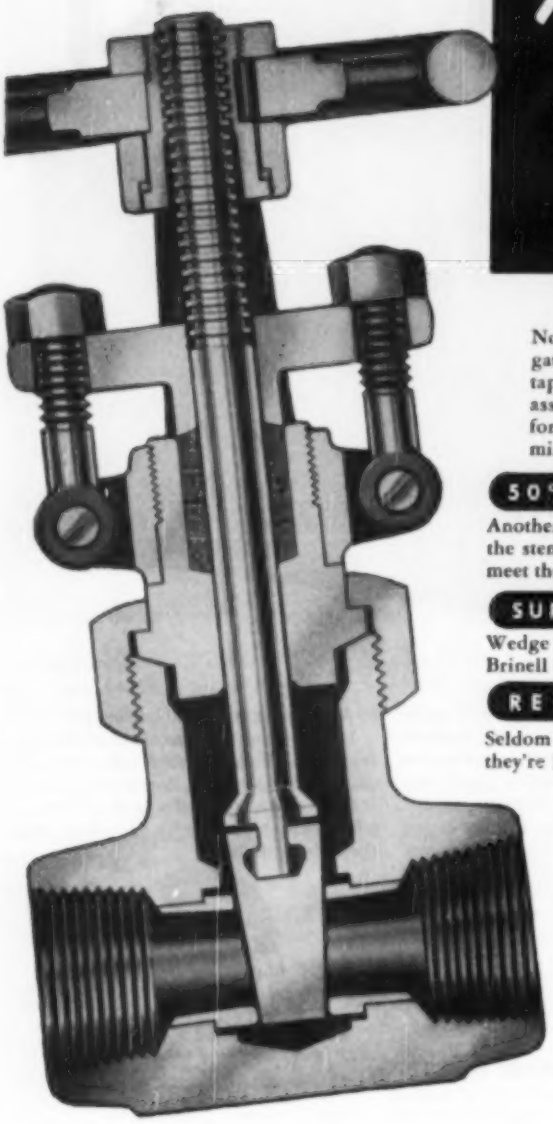
If you have any problems involving the use of Barrett* chemicals why not discuss them with the Barrett field representative. We will gladly send you booklets describing Barrett chemicals and their applications.

Barrett®

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ALLIED CHEMICAL & DYE CORPORATION
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5551 St. Hubert Street, Montreal, Que.
*Reg. U. S. Pat. Off.

BARRETT* CHEMICALS AVAILABLE TO THE PLASTICS INDUSTRY

"ELASTEX" 10-P Plasticizer • "ELASTEX" 28-P Plasticizer • "ELASTEX" 50-B* Plasticizer
"ELASTEX" DCHP Plasticizer • Dibutyl Phthalate • Phthalic Anhydride • Phenol • Crystal Urea



IF IT'S A CHAPMAN 960 YOU CAN *Repack Under Full Pressure*

No need to interrupt service to repack this small gate valve. You can do it under full pressure, for a tapered shoulder is provided on the stem and gate assembly which engages a seat in the bonnet forging. You repack easily, quickly — with minimum trouble.

50% STRONGER CONNECTION!

Another trouble-saver is the extra-strength now built into the stem and wedge gate connection. It's 50% stronger to meet the most extreme operating conditions.

SUPER-HARDENED WEDGE FACES!

Wedge faces, too, are extra strong — super-hardened to 800 Brinell by the exclusive Malcomizing process.

REPLACEABLE SEAT RINGS!

Seldom is replacement of these seat rings required, for they're hard heat treated — made with wear resisting and non-galling properties. But, if ever necessary, they're made so you can do the job easily...fast.

Specify List 960 in sizes ¼" to 2". Rising stem with yoke (illustrated) or rising stem inside screw type. For pressure range 2000 lbs. at 100 deg. F., 380 lbs. at 1000 deg. F. For higher pressures specify List 990.

The Chapman Valve Manufacturing Company

INDIAN ORCHARD, MASSACHUSETTS

Bulletin on SUPER REFRACTORIES

by CARBORUNDUM
TRADE MARK

NO. 10 NOVEMBER, 1930

How Can Super Refractories Justify Their Higher Initial Cost?

In adjudging the value of a super refractory for a particular job, price should not be the sole determining factor. *Their overall usefulness and the savings they can effect should be the measure of their worth.* Refractory cost per unit handled is a good yardstick.

With their exceptional resistance to furnace atmospheres, thermal shock, slags, cracking, mechanical wear and high temperatures, super refractories by CARBORUNDUM give exceptionally long service. They also extend the life of adjacent refractories, eliminate frequent furnace outages, increase production, and decrease replacements and labor costs.

Another unique property of certain super refractories that often justifies higher initial cost, is high thermal conductivity. This provides quicker, more uniform heat delivery to the charge. Material quality is bettered, fuel consumption reduced, rejects cut, and output improved.

Still other benefits are to be gained in certain other types of installations. These applications, too, are usually limited to areas which cause repeated costly repairs and shut-downs.

Super refractories by CARBORUNDUM are most often applied where other refractories, for any of many reasons, are incapable of doing an adequate job.

Physical Properties of Super Refractories by CARBORUNDUM

Trade Mark

	CARBOFRAX Silicon Carbide	MULLITE Electric Furnace Mullite	MULLITE S Corundum Mullite	ALFRAX K Electrically Fused Alumina	ALFRAX B Electrically Fused Alumina	ALFRAX 01
Heat Conductivity at 2200° F. in BTU/hr. sq. ft. and °F./in. of thickness	109 BTU	16 BTU	9 BTU	24 BTU	12 BTU	7 BTU
REFRACTORINESS PCE CONE	37-40	38-39	37-38	37-39	39-40	38-39
SPALLING RESISTANCE	High	High	High	Good	Good	Good
ABRASION RESISTANCE	High	Medium	Medium	High	Medium	Low
THERMAL EXPANSION (25° — 1400° C.)	.0000044	.0000059	.0000069	.0000074	.0000086	.0000086
MODULUS OF RUPTURE @ 2460° F. PSI	800-3125	100-250	175-475	100-1050	100-225	50-100
WEIGHT 9 IN. STRAIGHT	9.25 lbs.	9 lbs.	8 lbs.	10.1 lbs.	7.25 lbs.	4.8 lbs.

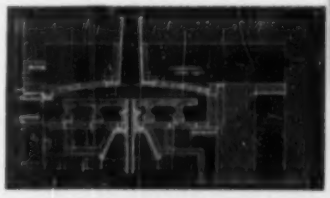


Here's How Super Refractory Skids Justified their Cost

Since the metal skid rails in this furnace were replaced with CARBOFRAX silicon carbide rails, output has increased and maintenance dropped. This furnace is used for heating and reforming splice bars at about 2300° F. The 2½" round, low carbon steel skids required complete replacement every six weeks. Two full working days were lost — shutdowns were costly. And even between replacements, the metal skids warped badly and required straightening.

Now, however, long uninterrupted production has been achieved. The CARBOFRAX skids have been in operation for *over 2 years* — and have required *no attention*. And as much as 35.4 tons of bars have been pushed through the furnace in seven hours.

The same unique properties of these CARBOFRAX skids have also made possible similar improvements in other reheating furnaces.



Super Refractory Doubles Furnace Output

When the fireclay dome in this Mannhiem type muriatic acid furnace was replaced by a CARBOFRAX silicon carbide arch *output was doubled*. What's more, this changeover cut the fuel input ratio by 50%.

In terms of initial furnace investment, this means that two furnaces equipped with CARBOFRAX arches *will out-produce four identical furnaces*

"Carborundum," "Carbofrax," "Mullitex," "Silfrax," "Alfrax" are registered trademarks which indicate manufacture by The Carborundum Company

Address all correspondence to: Dept. H-110, THE CARBORUNDUM COMPANY, Refractories Division, Perth Amboy, New Jersey

Continued on other side →

⇐ Continued from other side

having fireclay arches. The savings in maintenance, labor and fuel costs are obvious.

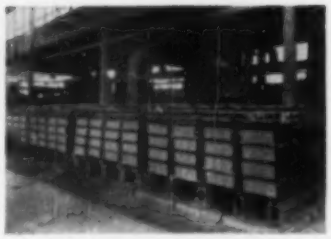
One of the unique properties of CARBOFRAX shapes making this possible is a thermal conductivity 11 to 12 times that of fireclay (nearly equivalent to that of alloy steel at high temperatures). Another characteristic is the high hot strength of CARBOFRAX brick and shapes. At 1350° C, for example, the modulus of rupture is well over 3000 psi. Furthermore, shrinkage is practically non-existant. Measured cold after 1¾ hours at 1500° C, actual tests show zero linear contraction. As a result, serious distortion — even with spans of 20 feet or more — is avoided, and dome life is much improved.



Maintenance Savings Pay for These Brick

Pictured here is the front wall of a 150,000 lb. per hr. pulverized coal fired boiler. The photo was taken three years after the CARBOFRAX silicon carbide burner rings had been installed and following the annual pointing-up and cement wash coating of the inner faces. None of the brick had been reset. The CARBOFRAX rings have resisted the abrasive action of the fuel as well as the spalling condition promoted by the secondary air around the burners. Considerable additional service is expected from these brick.

CARBOFRAX brick have been used to face the front wall above and around these burner rings. Previously, slag fingers built up on this wall, extended down over the burners and distorted the flame. As a result, it was necessary to shut down each month to bar off the slag. Now, however, slag fingers do not build up on the hard, dense face of the CARBOFRAX wall and these monthly shutdowns have been eliminated. Consequently, the operator considers that labor and maintenance savings alone have paid for the brick.



Tile Manufacturer Increases Car Capacity 40%

By changing from clay saggers to open settings with CARBOFRAX silicon carbide setter tile, I-beam posts and saggers, this floor and wall tile manufacturer increased car capacity approximately 40% — with no change of kiln schedule.

In this operation, bisque wall tile are fired on CARBOFRAX tile. The setter slabs and ware are carried on 3-point support of I-beam posts. Floor tile are burned in CARBOFRAX saggers on top of the car. And after each trip, the cars are torn down and rebuilt.

The high mechanical strength, freedom from warping and blistering, and resistance to thermal shock of CARBOFRAX kiln furniture, have resulted in important savings to this company. Super refractories by CARBORUNDUM and engineered car settings have made the difference — as has been the case in many other ceramic plants.



Super Refractory Proves Profitable for Incinerator Operation

This photo shows part of the interior of an incinerator operated by a large industrial city. The furnace is approximately 8' x 24', and operates at 1700° — 2400° F. CARBOFRAX silicon carbide brick are used from the grate level to the tubes, and CARBOFRAX shapes are used around the four stoking door openings.

Note the excellent condition of the CARBOFRAX brick after more than three years service. Note, also, the absence of fly ash and other accumulations despite the fact that these walls had not been cleaned for 1½ years. Compare this with the deposit above the tubes where other refractories are used. The difference is particularly pleasing to the operator because, with fireclay, brickwork was always pulled away in the process of removing these accumulations. Moreover, CARBOFRAX brick are very resistant to erosion and cutting back — an added problem when other types of linings were used.

Before the installation of CARBOFRAX brick, this incinerator needed complete rebuilding every two years, plus patching and replacements during this period. Now, however, periodic repairs have been eliminated, and even after three years CARBOFRAX brick still are satisfactory for considerably more service.

The high refractoriness, cracking and spalling resistance, and excellent hot strength of CARBOFRAX brick have been used advantageously in this job. Other product properties of special value around the stoking doors are resistance to thermal shock and mechanical abrasion.

This is another example of how the benefits of super refractories by CARBORUNDUM more than justify their original cost.

To obtain facts and figures on installations in specific fields merely select from this list of bulletins. Copies will be sent you at once. No obligation, of course.

- Super Refractories by CARBORUNDUM (general catalog)
- Super Refractories for the Ceramic Industry
- Super Refractories for the Process Industry
- Super Refractories for Boiler Furnaces
- Super Refractories for Heat Treatment Furnaces
- Super Refractories for Gas Generators
- The Frax Line of Cements
- CARBOFRAX Refractory Skid Rails
- Porous Media for Filtration & Diffusion

Dept. No. H-110

THE CARBORUNDUM COMPANY

Refractories Division

PERTH AMBOY, NEW JERSEY

Ladish Elbows



...A Complete Size Range Another Reason to Specify *Controlled Quality*

SEAMLESS WELDING FITTINGS

From the small fitting that weighs several ounces to the half-ton giant . . . whatever your fittings requirement, the Ladish line provides you with an unrestricted choice of sizes in a complete range of types, weights and materials. In addition, every fitting offers the added dependability assured by the high manufacturing and metallurgical standards of Ladish Controlled Quality.

THE COMPLETE FITTINGS LINE
PRODUCED UNDER ONE ROOF...ONE RESPONSIBILITY

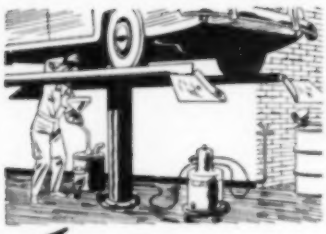
LADISH CO.

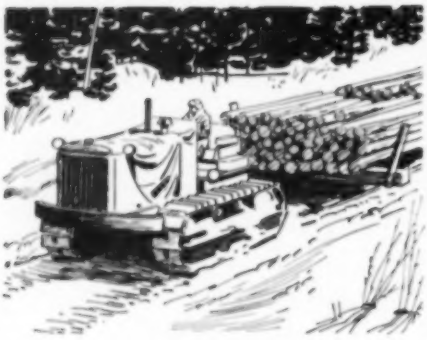
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PRESCRIPTION FOR INDUSTRY'S CHILLS AND FEVERS

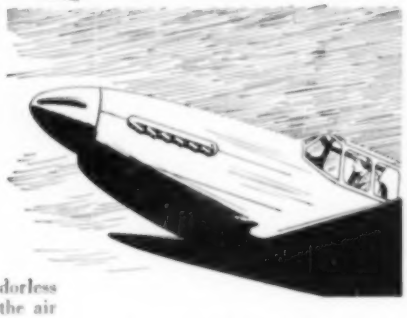




Rx







In scores of products and processes exposed to extremes of heat or cold, Wyandotte Glycols are "just what the doctor ordered." Hard to freeze, slow to boil, these even-tempered chemicals are proving their worth on industry's toughest proving grounds.

Today, they are being used widely as *permanent* anti-freezes in cars, trucks and machinery operating in frigid zones—in breweries, dairies, ice cream and meat packing plants. At the same time, they fill the need for *coolants* in aircraft engines where temperatures range above the boiling point of water alone.

These practically colorless, odorless liquids absorb moisture from the air and evaporate slowly. They make excellent agents for moistening and softening tobacco, cellophane, textile fibers, glue, gelatin and cork.

Glycols also find jobs in the manufacture of brake fluids, wood stains, perfume and cutting oils—as plasticizers and as solvents for oils, resins and dyes.

In fact, it is hard to find a modern industry in which these versatile chemicals do not play *some* part. Chances are they can be used to advantage in the products you make.

Why not write for further data on the properties and applications of Wyandotte Glycols? Just write Wyandotte Chemicals Corporation.

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Cincinnati 2, Ohio, 619 Gwynne Bldg. CHerry 4941
Detroit 26, Mich., 1319 Dime Bldg. WOodward 1-1014
New York 17, N. Y., 60 E. 42nd St. MUrray Hill 2-1780
Pittsburgh 22, Pa., 1114 Oliver Bldg. GRant 1-0640
St. Louis 3, Mo., 1430 Paul Brown Bldg. CHestnut 6373
San Francisco 3, Cal., 506 Crocker Tower Bldg. SUtter 1-1737

• • •

Wyandotte Chemicals Corporation

Wyandotte, Mich. • *Offices in Principal Cities*

Wyandotte

ORGANIC AND INORGANIC CHEMICALS

Wyandotte Chemicals Corporation is one of the world's major producers of soda ash, caustic soda, bicarbonate of soda, chlorine, dry ice and calcium carbonate. Wyandotte produces glycols and related compounds, certain aromatic sulfonic acid derivatives and other organic intermediates. Wyandotte is also the world's largest manufacturer of specialized cleaning compounds for business and industry.

Harbison-Walker

PLASTIC and CASTABLE Refractories

save time and money in



CHEMICAL PROCESSING PLANTS

The versatility of Harbison-Walker *Plastics and Castables* makes these refractories particularly useful in chemical processing plants. For applications such as walls, arches, door linings, insulated furnace sections and linings of irregular contour, there are Harbison-Walker plastic and castable refractories for a wide range of furnace operating conditions. They are especially convenient for emergency repairs and for making irregular shapes when urgently needed.

HARBISON-WALKER CASTABLES comprise all classes, fulfilling every special need for highest refractoriness, greatest strength, and maximum insulation. These castables are dry, hydraulic and ceramic-setting refractory concrete mixes, which, by the addition of water, are used in the consistency required for pouring or tamping into place.

H-W PLASTIC FIRE BRICK Refractories, available in Standard and Super Grades, are shipped in proper plastic consistency for immediate use. They are easily rammed into place for patching and maintaining furnace linings, as well as for new construction. Made from carefully selected calcined and bond clays of highest quality, H-W Plastic Fire Brick resists destructive spalling and slagging influences.

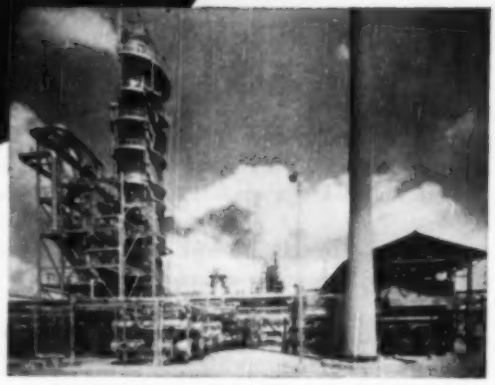


Harbison-Walker Refractories Company
AND SUBSIDIARIES

World's Largest Producer of Refractories

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In mid-July a new and complete lubricating oil plant went on stream at SOHIO's large Lima refinery. Lummus designed and built four of the five processing units which will produce approximately 1800 barrels per day of high grade lubricating oils.

Lummus applied new and improved techniques in the design of SOHIO's lube-oil plant. A new fluidized method of clay handling is employed in the contact units. A hot oil-belt system provides all the heat required for the FURFURAL, MEK, and CLAY-CONTACT Units. A single console instrument panel is used to control the operation of the FURFURAL and MEK Units.

The Lima plant reflects the leading role Lummus has played in the building of outstanding lube-oil refineries. Lummus has designed and constructed over 115 lubricating oil processing units. To a study of your individual problems, whether solvent refining, the modernization and expansion of existing units, or new projects, Lummus can add the experience gained through years of designing and building petroleum, petroleum chemical and chemical plants.



PETROLEUM HORIZONS, the new 80-page book on Lummus processes and plants, features a step-by-step description and flow sheets for 31 refinery processes. Your copy available on request.

THE LUMMUS COMPANY

designing engineers and constructors for the petroleum and chemical industries

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TRADEMARK

Formaldehyde in Alcohol

The practicability of handling a relatively water-free alcohol solution of formaldehyde at regular temperatures in standard equipment has been proven by Celanese research and development groups. Cost savings and convenience of handling are among several advantages this Celanese product offers processors of formaldehyde-alcohol end products.

FORMCEL is a solution of formaldehyde in alcohol. Currently this latest Celanese product is available in semi-works quantities in the following alcohols:

55% Formaldehyde in Methanol
40% " " "
40% " " Propanol
40% " " Butanols

Formcel is the direct result of pioneering work in formaldehyde chemistry carried on at the Celanese Petroleum and Research Laboratory at Clarkwood, Texas. We will be glad to send you additional data and other information covering this significant Celanese development. Write: Celanese Corporation of America, Chemical Division, Dept. 530-K, 180 Madison Avenue, New York 16, N. Y.

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COPPER ALLOY BULLETIN

REPORTING NEWS AND TECHNICAL DEVELOPMENTS OF COPPER AND COPPER-BASE ALLOYS

Prepared by Bridgeport Brass Company "Bridgeport" *Headquarters for BRASS, BRONZE, and COPPER*



This dented aluminum brass condenser tube was injured through impingement corrosion, Mag 2.5X.

Aluminum Brass Doubles Life of Station's Condenser Tubes

The ability of aluminum brass condenser tubes to withstand impingement corrosion far better than Admiralty is evidenced in a study of operating conditions at a seaboard power station.

Prior to 1937, Admiralty tubes had a life of five to seven years at this plant. Failures occurred both from impingement corrosion at the inlet ends of the tubes and dezincification.

Since retubing with aluminum brass, starting in 1937, there have been no tube failures.

The brackish cooling water used contains considerable entrained air. Marine organisms—algae, slime, clams, mussels and fish—are present.

Water velocities are between 6.8 and 7 feet per second. Turbulent flow at this velocity with entrained air is particularly destructive to Admiralty tubes.

Tube Cleaning Eliminated

Although waterboxes and tube sheets are cleaned at intervals, neither plugging nor any other method of tube cleaning has been found necessary.

Marine fouling is controlled through the use of rotating screens and residual chlorination. Two to three times during each eight-hour shift—depending on the season—chlorine is bled through diffusers into the water flowing through the intake tunnel.

As a means of removing as much air as possible, each condenser is vented at the division plate (two-pass type).

One condenser at the plant has an exceptionally turbulent waterbox which has been attributed to the design of the pump, condenser, and piping. Despite this, the aluminum brass tubes installed in 1937 are just starting to show signs of impingement attack at the inlet ends.

Effect of Impingement Corrosion

In impingement corrosion of Admiralty, the normal protective film is rapidly removed until the base metal is exposed. This exposed metal then corrodes away at a much higher rate than normal. In some materials this may be as much as 50 to 100 times more rapid than the normal rate. The depth of the corrosion pits depends upon the length of time that the stream of water strikes the same spot on the tube wall.

Healing of Tube Film Vital

Rapid healing of broken films is an outstanding characteristic of aluminum brass as well as arsenical aluminum bronze and 70-30 cupro nickel. Films on these alloys may readily repair themselves under conditions where an alloy such as Admiralty would not unless the condenser is completely shutdown. This explains why these alloys withstand impingement corrosion so successfully.

Many stations used to have sufficient capacity so that they could shutdown condensers from time to time. These rest periods allowed the films to rebuild themselves in Admiralty tubes and consequently good service was obtained. Nowadays, these shutdowns seldom occur and therefore satisfactory service life cannot be obtained from Admiralty where severe impingement corrosion is a factor. It is important to use those alloys which stand up better under conditions approximating continuous operation.

Dents Lead to Corrosion

Dents formed on the outside of the condenser tube, resulting from improper handling during shipment or installation, can lead to local failure of tubing. Water striking the bump inside the tube may cut through the protective film of even the more resistant alloys and thin the wall locally until perforation occurs. A similar situation occurs when an obstruction lodged in the tube deflects the stream of water against the tube wall.

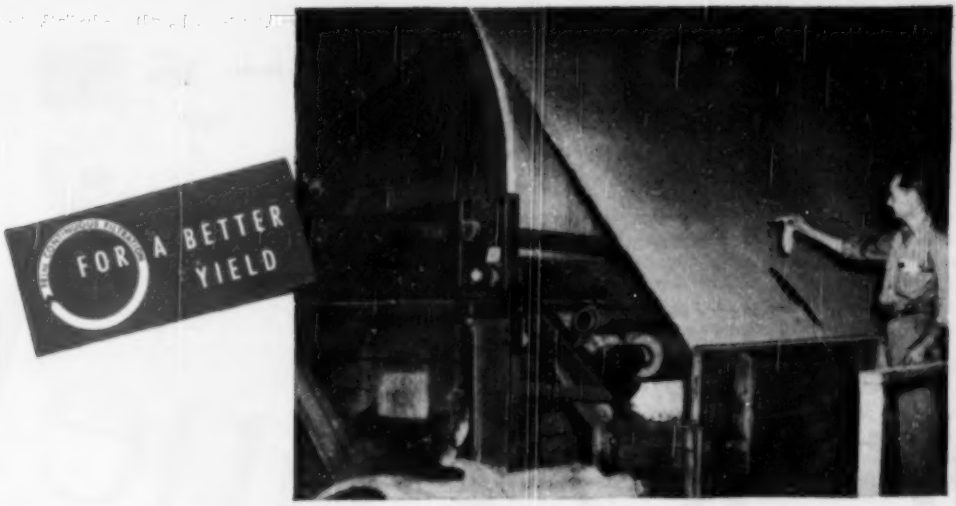
The scouring effect of water carrying silt or sand—as well as entrained gases—tend to produce wall thinning.

Since water conditions also affect the rate of impingement corrosion, it is advisable to call on the services of Bridgeport laboratory to help select the alloy best suited to your needs. Write for our Condenser Tube Manual containing information on the corrosion resistance and other characteristics of various tube alloys.

BRIDGEPORT BRASS

BRIDGEPORT BRASS COMPANY, BRIDGEPORT 2, CONN. • *ESTABLISHED 1865*

Mills at Bridgeport, Connecticut, and Indianapolis, Indiana • In Canada: Noranda Copper and Brass Limited, Montreal



CLEANER, DRYER CAKE *Continuously* with FEinc STRING FILTERS

FEinc Saves on:

ALUMINA HYDRATE
ALUMINUM STEARATE
BARIUM SULPHATE
CALCIUM CARBONATE
CALCIUM HYPOCHLORITE
CLAY
DDT
DISODIUM PHOSPHATE
IRON OXIDE
LACTIC ACID
LITHOPONE
MAGNESIUM HYDROXIDE
NEUTRALIZED WASTE
PICKLE LIQUOR
PENICILLIN
SEWAGE
SILICA GEL
SODIUM CARBONATE
SOYBEAN PROTEIN
STREPTOMYCIN
STARCH:
CORN, POTATO, RICE, WHEAT
TITANIUM HYDRATE
2,4-D
WHITE LEAD
ZINC OXIDE
ZINC STEARATE
and many others

Because it gives a cleaner, dryer cake and clearer filtrate without "stop and go" losses, the FEinc rotary vacuum filter proves out with a bigger yield on job after job. It's the String Discharge that does it. Endless strings neatly pick the cake off the cloth in one continuous sheet. Smearing, blinding and scraping wear are eliminated, hence you use finer filter cloths which come close to being ideal. FEinc handles cakes as thin as 1/16 in. or as thick as you want, ranging from "impossible" slimes to matty, fibrous cakes. Other features: The FEinc compression dewatering mechanism removes more moisture, and the FEinc submergence washing mechanism washes cakes down to unbelievable purity. Here are three typical jobs:

Manufacturer changed entire process when scraper filters plugged up after few revolutions on new, sticky, clay-like material. Tests on FEinc Filter showed no plugging after three days. Manufacturer returned to original process at lower costs—with FEinc Filters.

To wash out sulphates, difficult gelatinous cake was recycled no less than nine times on ordinary washing filters. FEinc cut it down to five cycles, delivered pure cake.

Considerable loss, wet cake, and low capacity resulted from scraper filter on calcium carbonates. Same size filter with FEinc String Discharge and Dewatering used lighter, more efficient cloth. Said user: "filtrate is clearer . . . cake pick-up is better," and above all, cloth lasted 50% longer.

WRITE FOR TECHNICAL BULLETIN 103

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② For a wide range of products

③ Rapidly and economically in

④ BUFLOVAK Vacuum Rotary Dryers

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① BUFLOVAK Vacuum Rotary Dryers give profit-building results. They are used for drying materials requiring low temperature and agitation, and for the recovery of volatile solvents from materials or dregs after leaching or extraction processes.

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④ BUFLOVAK Vacuum Rotary Dryers are built in various designs and sizes, including sanitary types, to meet every industrial requirement. Special features may include dust-tight housing for charge and discharge doors, equipped with locking devices and lifting mechanism. Built-in spray nozzles can be furnished to flush the dryer.

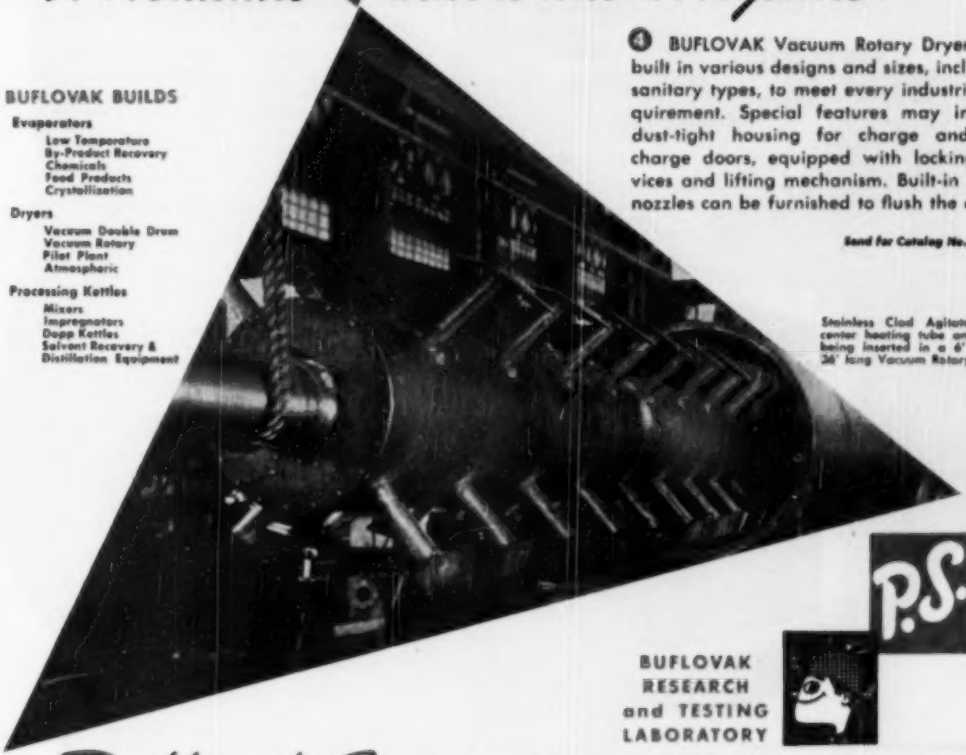
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Evaporators
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Stainless Clad Agitator with center heating tube and arms being inserted in a 6' dia. x 36' long Vacuum Rotary Dryer.

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YOU CAN BE **SURE**.. IF IT'S
Westinghouse



Ignitron Rectifiers—
Show Best Conversion Efficiency

Perfected by Westinghouse engineers in 1937, Ignitrons today are the chemical industry's Number One conversion method. They show the best conversion efficiency, lowest first cost for operation above 200 volts, and supply many cells in series. Ignitrons require very little maintenance and human attention (many installations are unattended). Shown at left: twelve Ignitron assemblies supply 60-thousand amps at 525 volts to electrolytic cells.



Motor-Generator Sets—
Have Wide Voltage Range

Once the leader in power conversion, M-G sets are still important where high current or variable d-c output voltages are needed. Voltage is easily regulated by controlling the generator field. For supplying 100 to 200 volts to cells in series, M-G sets have highest conversion efficiency. At left are five Westinghouse M-G sets which feed 50,000 amps to cells producing magnesium.

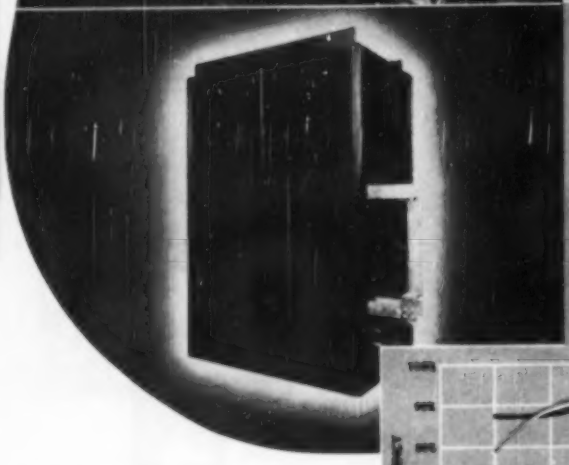
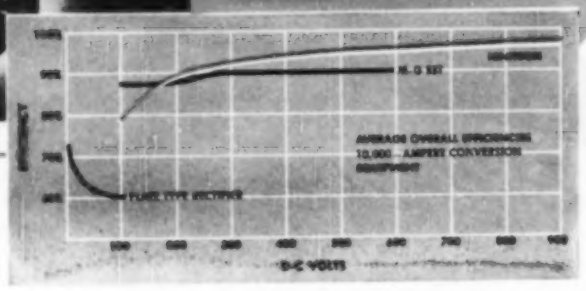


Plate-Type Rectifiers—
Permit Precise Cell Control

Copper-oxide and Selenium Rectifiers are best for low-voltage power (25 volts and under) for a small group of cells. They permit unusually precise cell control. Units are suited to variable output voltage. They require practically no maintenance and can readily be set up for automatic operation. Shown at left is a Selenium Rectifier for electrolytic operations. Interior of this unit is pressurized to prevent entry of corrosive gases.



ARE YOU WASTING MONEY IN POWER CONVERSION?

Conversion Method Has Big Effect on Power Costs, Cell Operation

In a big electrochemical operation, a 5% difference in conversion efficiency can make a $20,000 difference in the annual power bill. A small improvement in voltage regulation can make major improvements in cell operation. So selecting the *right* conversion method can pay big dividends in power savings, production efficiency, product quality and equipment maintenance.

Westinghouse Makes All Three; Gives Unbiased Advice

Almost every electrochemical process is different—and the tricky problem is matching the conversion equipment to the needs of your operation. Here's where Westinghouse can really help—because we've had a great deal of experience in the manufacture and application of *all three* important conversion methods. We know the advantages and best operating practice for each—Ignitrons, motor-generator sets, and plate-type rectifiers. Thus we can give you expert, *unbiased* advice in selecting new equipment or getting the most out of your present installation.

Review Your Operation; Have Westinghouse Help

A thorough study of your present conversion operations could mean big savings. A Westinghouse specialist would be glad to help you review them—with no obligation of course. Just call your Westinghouse office. And when planning new installations, be sure to call in Westinghouse early. Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Penna. J-94857

Westinghouse

EQUIPMENT FOR THE CHEMICAL INDUSTRY

AN IMPORTANT PART OF ANY PLANT



Here you see a recent aerial view of the huge Jeffrey plant and general offices in Columbus. Recently completed in our modernization program is the Chain-making Department, a new Steam Generating plant, and the purchase of many new machine tools for the various shops. The Jeffrey plant is as modern as progress will permit. We have made this investment in the future—for YOU.

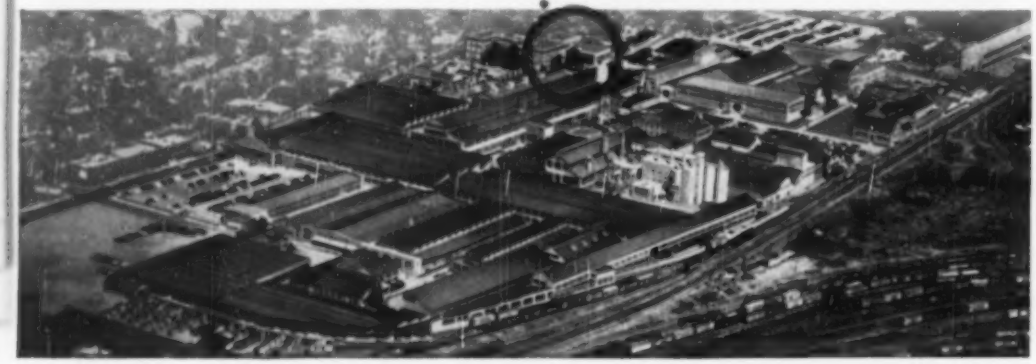
Nestling among many buildings in our 48-acre Jeffrey Plant is our Research Center. Small in comparison, perhaps, to those buildings housing our manufacturing facilities but a vitally important part of the company's vast operations.

It is in this Research Center that encouragement and unlimited opportunities are provided so that Jeffrey products can be made scientifically better. It is equipped with the finest tools available and staffed with experienced technicians and engineers to lend their skills whenever needed.

It is here that tests are performed on drying, cooling, packing, crushing, conveying and other processing operations on a semi-plant scale . . . tests of sufficient scope to insure accurate predetermination of field results. Samples may be sent . . . confidential experiment on your own material witnessed.

In addition, a constant check on quality, strength and life of the various metals used in the manufacture of Jeffrey equipment is made in our Chemical and Metallurgical Laboratories.

Our aim: "Better Products—for Better Mechanization —for Better Working Conditions." We will be happy to serve your requirements.



THE JEFFREY MANUFACTURING COMPANY Established 1877

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Complete Line of Material Handling, Processing and Mining Equipment

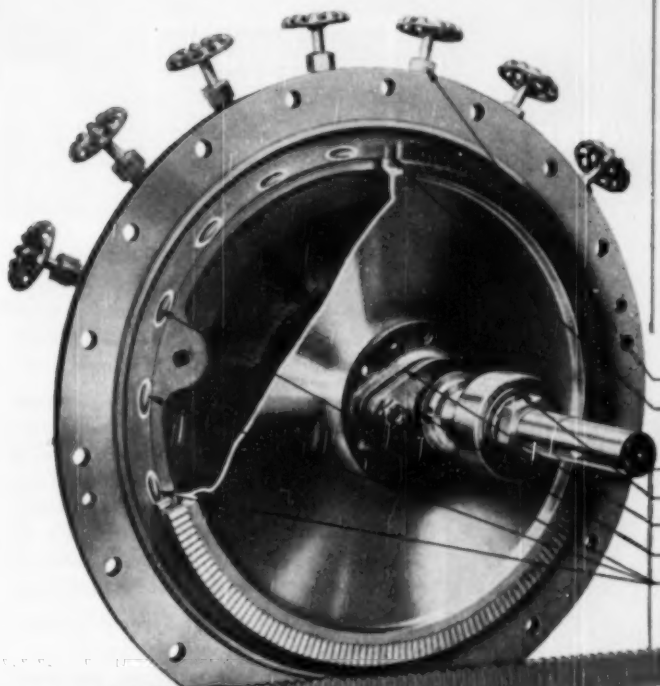
Baltimore 2 · Boston 16 · Cincinnati 2 · Detroit 13 · Jacksonville 2 · Philadelphia 3 · Salt Lake City 1
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No other steam turbine offers you

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The larger number of hand valves you see on a Coppus Steam Turbine promises you greater operating economy. At least 60% of the steam nozzles can be individually controlled to give maximum steam pressure in steam chest . . . a guarantee of best water rates at any load. Maintenance economy, too, is assured by the hard chromium plating of the shaft at the stuffing box. It provides the best possible smooth, non-corrosive surface for packing rings.



- 7 hand valves for efficient partial load operation, (20" turbine shown)
- 2 row velocity-stage turbine wheel with stainless steel turbine buckets — statically and dynamically balanced
- 30-40 carbon steel shaft
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- Stuffing box with metallic packing ring
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Coppus Steam Turbines, Type TF, driving chemical transfer pumps at Celanese Corporation of America's Chemcel Plant

Coppus Steam Turbines ranging from 150 hp down to fractional in 6 frame sizes

MAKE TURBINE DOLLARS GO FARTHER

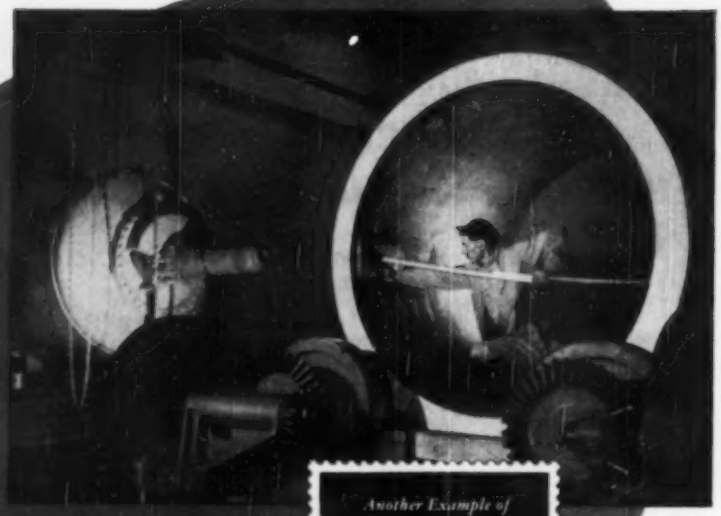
Why waste money buying turbines with higher horsepower ratings than you need? The higher the horsepower rating, the higher the price. Save money by selecting the Coppus Turbine size closest to your requirements from 150 hp down to fractional. And when you do, you save operating and maintenance costs, too. That's what these other Coppus features are designed to do: exclusive pilot operated excess speed safety trip supplementing constant speed governor; choice of metallic or carbon ring packing assemblies. Designs available for back pressures up to 75 pounds; replaceable cartridge type bearing housings. For full details . . .

WRITE FOR BULLETIN 231

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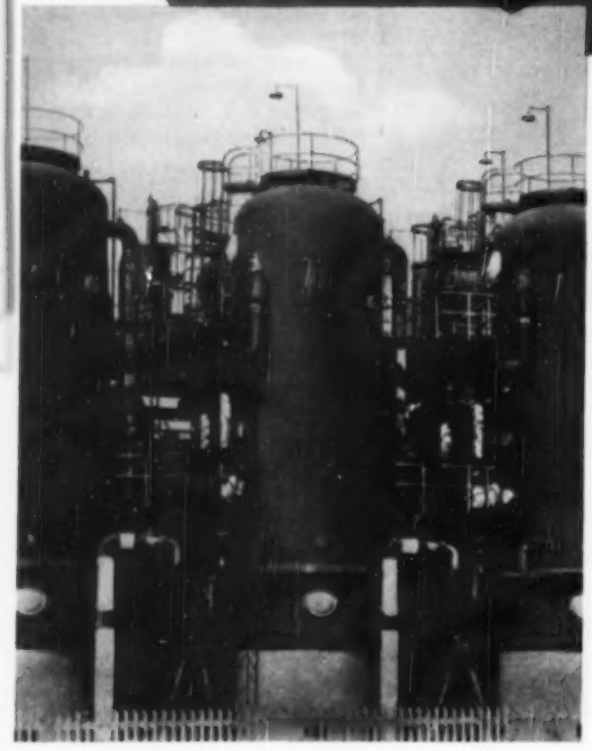
COPPUS "BLUE RIBBON" TURBINES

This Plus Value in B&W process equipment



Another Example of B&W Research, Engineering and Facilities

PAYS DIVIDENDS HERE



Final test of the workmanship and materials in every B&W pressure vessel is the X-ray or radiographic inspection of all main welds.

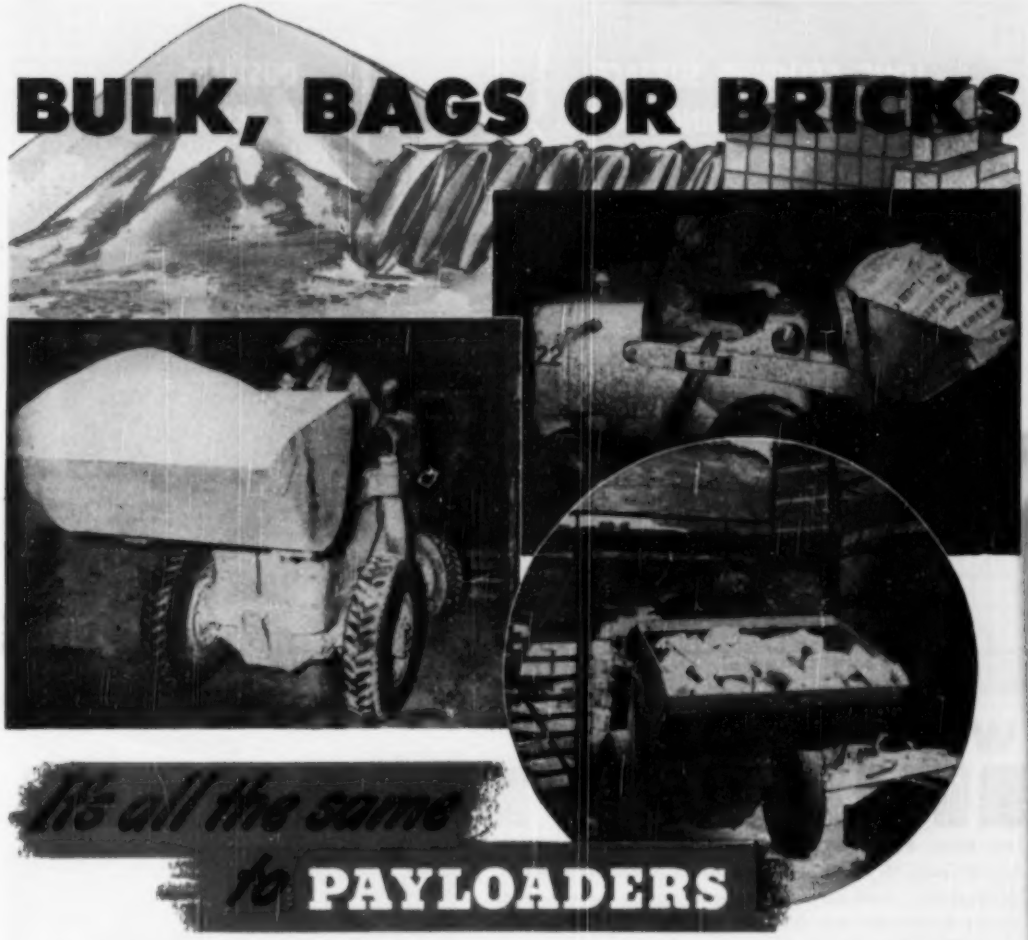
For twenty years B&W has pioneered in developing non-destructive testing techniques. As examples, B&W was the first to use one-million and two-million-volt X-ray machines in testing weldments; current B&W research in the industrial uses of radioactivated cobalt has already produced valuable published data—and is continuing.

This kind of research approach to problems of pressure-vessel fabrication . . . together with long experience and unexcelled facilities . . . make B&W a leading source of process equipment for long, dependable, trouble-free service.

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"PAYLOADERS" have the power and traction to scoop up big bucket loads of tough, lumpy, granular, sticky or abrasive materials . . . have the speed and maneuverability to carry their loads *fast* outdoors or indoors, over hard surfaces or ground, mud or snow . . . to work in close quarters, to unload box cars. They dump their loads directly into piles, trucks, cars, bins, containers or hoppers—high or low, slow or fast—by means of controlled hydraulic power.

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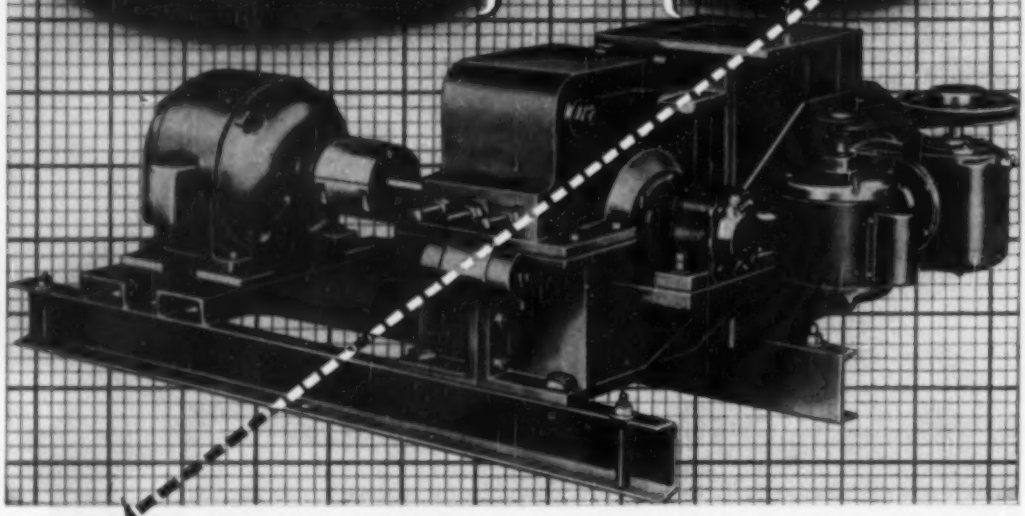


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LONG GRINDING SURFACE
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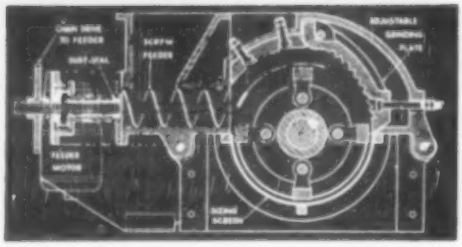
= DUSTLESS FINE GRINDING (100 to 325 MESH)



WILLIAMS HELIX-SEAL HAMMERMILL

NO FANS, CYCLONES OR SEPARATORS. Material fed into screw feeder is discharged at bottom of mill completely pulverized . . . with no oversizes or tailings to be separated. Screw feeder also acts as a seal against inrush of air. No dust! Williams' Helix Mill grinds many materials to 325 mesh. 100 to 200 mesh products are common on more difficult materials. Yes! It'll grind wet and sticky materials, too! Variable speed control permits grinding of different kinds of materials. **EASY, INEXPENSIVE TO INSTALL AND OPERATE!** Small floor space and lack of vibration calls for simplest of installation. Only requirement is a tight bin below mill with some sort of outlet. All parts are easily cleaned . . . on most materials simply by brushing. Feeder drive consists of roller chain drive from fractional horsepower gear head motor to feeder screws.

WILLIAMS PATENT CRUSHER & PULVERIZER CO.
2706 N. NINTH STREET ST. LOUIS 6, MO.



Sectional view of Helix-Seal Mill. Note long grinding plate against which the material is ground before it reaches the sizing screen. This plate is adjustable to compensate for wear.

WILLIAMS ALSO MAKES . . .

Heavy-duty hammermills; impact and roller mills for 200 to 325 mesh grinding; drier mills; air separators; vibrating screens; steel bins; complete "packaged" crushing and grinding plants.

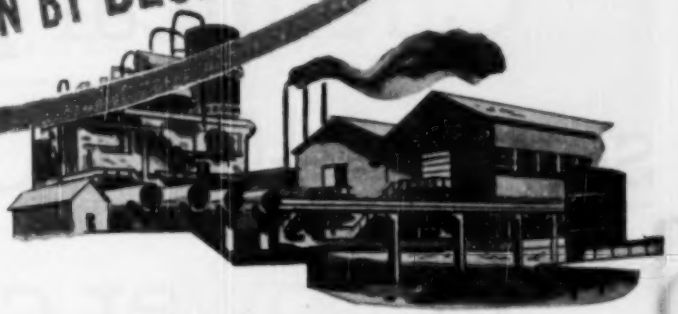
WC40-7

WILLIAMS

CRUSHERS GRINDERS SHREDDERS

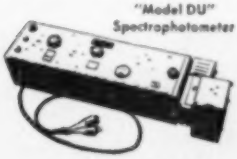
The Mark of a Modern Chemical Processing Plant...

INSTRUMENTATION BY BECKMAN!



In both industry and science the name "Beckman" has become synonymous with leadership in a vital field of instrumentation—that of adapting complex scientific instruments to the quick and accurate solution of modern analytical and control problems. If you are not using these Beckman Instruments in your operations, you should investigate today the important savings they can make for you . . .

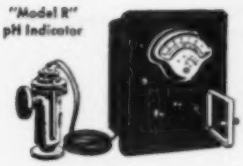
"Model DU" Spectrophotometer



"Model B" Spectrophotometer



"Model H" pH Indicator



OTHER BECKMAN INSTRUMENTS include IR-2, IR-3 and Flame Spectrophotometers, Radioactivity Meters, Photopen Recorders, Flow Colorimeters, Ultrohmeters and other advanced instruments. For the most modern in instrumentation, consult Beckman!

THE BECKMAN QUARTZ SPECTROPHOTOMETER

is ideal for industrial and research laboratories to facilitate the speed and accuracy of chemical analyses . . . of color-matching paints, textiles dyes, paper, etc. . . . of controlling quality and uniformity in the production of drugs and pharmaceuticals . . . of simplifying metallurgical analyses, hydrocarbon determinations and many other diversified applications. This versatile instrument covers the ultraviolet, visible and near-infrared spectral regions, and gives both % Transmission and Density readings on solid, liquid and gaseous samples. It is unusually simple to operate, incorporates many unique design features that insure sustained accuracy and dependability, and it can be used with a wide range of accessories to further increase its all-around utility.

THE BECKMAN "MODEL B" SPECTROPHOTOMETER

combines many unique spectrophotometric advancements in a low priced instrument that is particularly suited for routine analytical operations. This instrument has better ultraviolet performance, better resolution, better wavelength and photometric accuracy, and more freedom from stray light than any other instrument in its price field. It has many uses in industrial laboratories for simplifying analytical operations in chemical, metallurgical, pharmaceutical and hydrocarbon processes—as well as for quick, accurate color-matching applications in textiles, paints, paper and other similar fields where close color control is essential. It covers the visible region as well as portions of the ultraviolet and infrared spectrums and can be used on liquid, solid or gaseous samples. The "Model B" brings the speed, accuracy and versatility of modern spectrophotometric analytical methods into the price range of even the most modest laboratory—yet it incorporates vital features found in no other instrument in its field.

BECKMAN GLASS ELECTRODE pH INSTRUMENTS

are universally recognized as leaders in the industry. Not only does Beckman provide the widest variety of pH meters—portable, research, AC-operated and battery-operated, as well as completely automatic equipment for large-scale process control—*but Beckman also provides the industry's greatest variety of glass electrodes for use with its instruments.* Since the accuracy and utility of pH equipment is limited by the electrode systems available for use with it, Beckman's unequalled range of glass electrodes is of utmost importance.

Wherever there is water or water solutions—slurries, moist pastes or moisture-containing semi-solids such as cheeses, doughs, jellies, etc.—there is pH. If you have fluid processes or products *anywhere* in your operations, chances are you can save time, minimize waste, by Beckman-controlling the pH of your operations. *Write outlining your problems and our experienced engineers will be glad to assist you without obligation.*

Our trained research staff will outline the important savings you can make by installing Beckman instruments on *your particular* operations. Write, wire or phone for further details. *Beckman Instruments, National Technical Laboratories, South Pasadena 14, California*

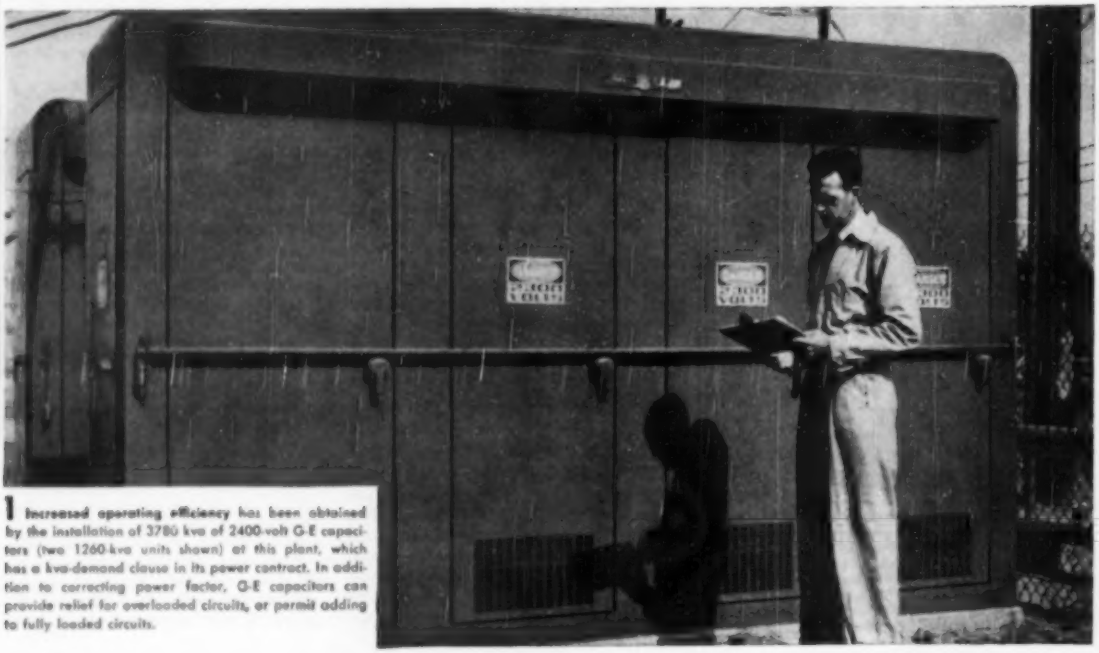
BECKMAN

INSTRUMENTS CONTROL MODERN INDUSTRIES

pH Meters and Electrodes—Spectrophotometers—Radioactivity Meters—Special Analytical Instruments

A PHOTO-REPORT ON MODERN

Chemical plant saves $40,000 a year in power costs!



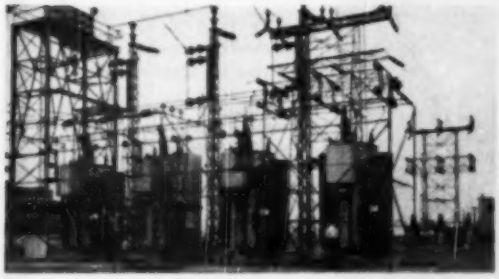
Increased operating efficiency has been obtained by the installation of 3780 kva of 2400-volt G-E capacitors (two 1260-kva units shown) at this plant, which has a kva-demand clause in its power contract. In addition to correcting power factor, G-E capacitors can provide relief for overloaded circuits, or permit adding to fully loaded circuits.

GENERAL ELECTRIC

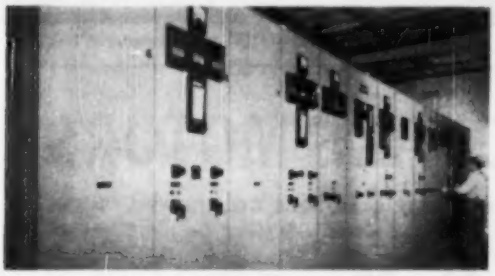
663-35

G-E capacitors—recently installed in large West Coast chemical plant—yield an estimated 50% annual return, increase efficiency of plant's power distribution system!

Savings realized by this company are just one example of the deep cuts that G-E capacitors can make in your chemical-plant power costs. Less dramatic, but vital to continuous production, is uninterrupted power supply. It's provided by reliable G-E power distribution equipment and co-ordinated to your individual needs by experienced G-E application engineers. For the whole story of the savings it makes possible, check your local G-E office—soon. *Apparatus Department, General Electric Company, Schenectady 5, New York.*



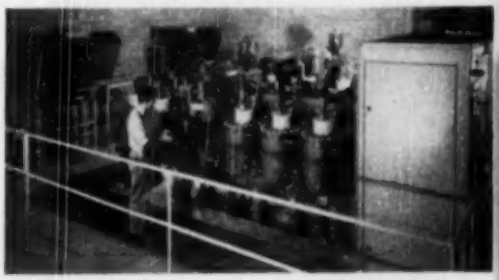
2 Incoming utility power is stepped down at these 4 G-E 5000-kva transformers from 112 kv to 22 kv for primary distribution throughout the plant. G-E transformers are available in all kva ratings and voltages to meet a wide variety of chemical-plant needs.



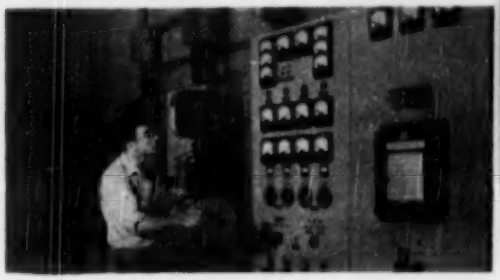
3 For continuity of power to vital loads, the plant uses a secondary selective system utilizing a 7500-kva 22,000/2400-volt G-E double-ended unit substation. Indoor portion shown is G-E metal-clad switchgear, a compact, assembled unit that saves installation costs.



4 Power losses are cut by G-E unit substations in load center systems. Shown here is the outdoor portion (two G-E 3750-kva transformers) of the plant's G-E unit substation that supplies power to miscellaneous compressor and motor loads located throughout the plant.



5 Conversion from a-c to d-c for electrolytic processes is provided by these two G-E ignitron rectifiers, high in conversion efficiency, rated 3000 kw, 650 volts, 5000 amperes. Their control cubicles are shown in right foreground, and their anode circuit breakers in left background.



6 Centralized control for the G-E ignitron rectifiers is obtained by means of this G-E switchgear and metering panel, where operator controls primary and rectifier breakers, and in addition obtains all necessary overcurrent relay, load current, and voltage indication.

POWER DISTRIBUTION SYSTEMS
for Chemical Plants



1 1561—A crude, manually operated bellows like this was used in an attempt to pump fresh air into a mine in Switzerland. And man's quest for comfort, by putting air to work, was under way.



2 1700—This age-old method of moving air for its cooling effect was used in many parts of the world. Needed was a form of low-cost power that would move air mechanically, automatically, and efficiently.



3 1873—This steam-operated, forced draft fan promoted efficient burning of fuel in boilers. By 1915, Howell Electric Motors arrived. The era of electrical power put the handling of air on a paying basis.

NOW... AIR IS PUT TO PROFITABLE USE!



4 **Today**—air is universally used for comfort — for profit!

For example, more heat, more steam is obtained on these two modern steam generators with automatically controlled blowers, powered by Howell Motors. Fuel costs are cut, efficiency increased.

You'll find Howell Motors putting air to profitable use in many ways—driving fans, blowers, exhausters, air washers, compressors, and other important equipment.

Every user has a good word for Howell. Because Howell Motors are industrial motors precision-built for the tough applications in industry.

Specify Howell next time you buy motors.

Equipment courtesy L. J. Wing Mfg. Co.

Free enterprise encourages mass production, supplies more jobs—provides more goods for more people at less cost.



Howell Protected-Type Motor

HOWELL MOTORS

HOWELL ELECTRIC MOTORS CO., HOWELL, MICH.

Precision-built Industrial Motors Since 1915

HOWELL Red Bond MOTORS

THEIR JOB is to help you get..





Mr. Claude Waltz, operating a Bullard high-speed boring mill here, started at OIC in 1896, at age 19, as an apprentice machinist.

Precision Engineering of valve designs, Precision Manufacturing and Precision Application—OIC considers all three factors equally essential to good valving. OIC has the years of experience and the service organization to give you all three.

We point with pride to these veteran members of the OIC organization as evidence: Mr. Claude Waltz has been contributing precision machining for 54 years. Mr. D. B. Malaney, Metallurgist, Mr. H. G. Doster, Vice President in Charge of Engineering, and Mr. J. B. Turner, Product Engineer, combine 40 years of service in precision engineering. Mr. A. A. Kruse, Jr., who began in our Engineering Department, is now one of the many field engineers advising users on precision valve application in various parts of this country.

If you're needing valve *application know-how*, call the nearby OIC distributor for the help of a factory representative, or write direct to us. The Ohio Injector Company, Wadsworth, Ohio.



This new, modern Southwark-Emery physical test machine, in daily use, is one of the many mechanical aids added to the 40 years of precision engineering experience of Messrs. Malaney, Doster and Turner.



Mr. A. A. Kruse, factory trained in precision application of valves, is one of many O. I. C. representatives in various parts of the nation qualified and available to aid both distributors and users in valve application.

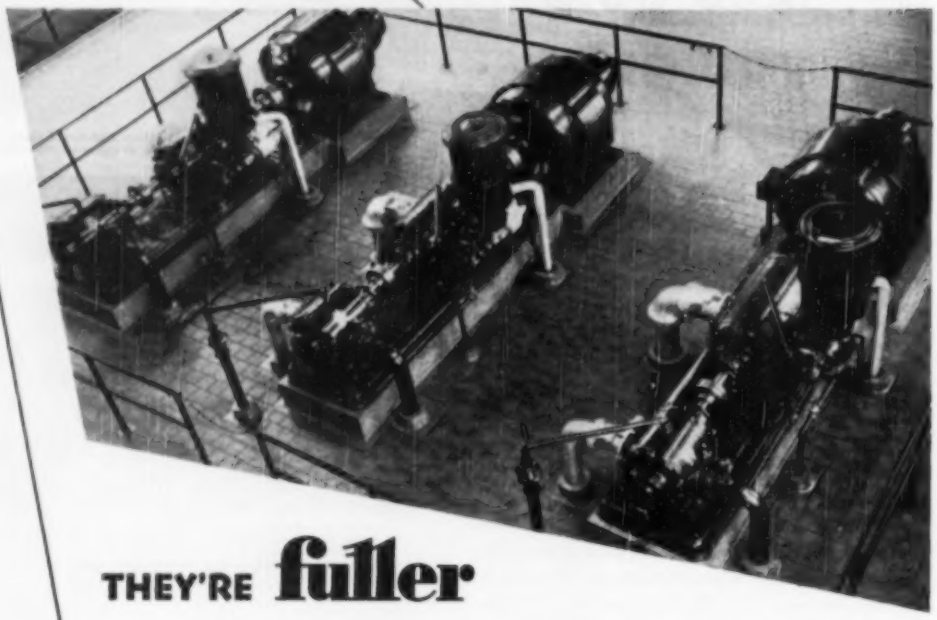
OIC
FOUNDED 1881

VALVES

FORGED AND CAST STEEL · IRON · BRONZE



THEY'RE COMPACT . . .
CLEAN-CUT . . .
EFFICIENT . . .
PULSATION-FREE



THEY'RE fuller

One West Coast manufacturer never has to worry about air for pneumatic services in his plant. He's installed a battery of three Fuller Rotary Two-Stage Compressors. Each has a capacity of 1085 cfm, 100-lb. pressure. The installation is compact, is streamlined, clean-cut, efficient in operation. Vibration is kept at the minimum. And what's especially interesting is the fact that they require no heavy foundations. In this particular installation, they have been mounted on comparatively light terrazzo foundations *. . . and they're on an upper floor of the building.*

Fuller Rotary Compressors are designed and built to give a lifetime of new machine service. They're simple in design, are easily operated, ruggedly built. Thousands of Fuller Rotary Compressors are maintaining peak efficiency in plants of every size and description throughout the country. They've *earned* their reputation for complete dependability.

Bulletin C-5 gives you complete information on these quality compressors. You'll want to study it carefully . . . see how well Fuller fits into your own plans and operations.

fuller

DRY MATERIAL CONVEYING SYSTEMS AND COOLERS—
COMPRESSORS AND VACUUM PUMPS—
FEEDERS, AND ASSOCIATED EQUIPMENT

FULLER COMPANY, Catasauqua, Pa.
120 So. LaSalle St., Chicago 3
420 Chancery Bldg., San Francisco 4

C-196

WeldELLS®



Let's get down to fundamentals: — There is only one *permanent* way to join pipe — only one joint as strong as the pipe itself — the properly *welded* joint.

A properly welded joint involves just two basic factors — a good fitting and good welding. In the WeldELL line you have not only the fitting that expresses the highest development in engineered strength and closely controlled metallurgy . . . you also have the fitting with features that enables the welder to do his job better and faster.

The WeldELL line embraces the widest range of sizes, weights, types and materials. In many sizes and types there are no fittings BUT WeldELLS!

TAYLOR FORGE

TAYLOR SPIRAL PIPE is again promptly available in a broad range of sizes and thicknesses. Coupon brings new Spiral Pipe Bulletin 493.

TAYLOR FORGE & PIPE WORKS
P. O. Box 485, Chicago 90, Illinois
Offices in all principal cities: *Eastern Plant:* Carnegie, Pa.
Western Plant: Fontana, Calif.

☐ Please send Catalog 484 covering welding fittings and forged steel flanges.
☐ Send Bulletin 493 covering Taylor Spiral Pipe and related fittings.

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Mail to Taylor Forge & Pipe Works, P. O. Box 485, Chicago 90, Ill.
513-1150



ELEVEN ACRES OF FOUNDRY FACILITIES

The above 24,000 pound 18% chromium and 8% nickel stainless steel hydraulic turbine runner casting was recently produced in the Newport News foundries for the Hoover Power Plant in Nevada.

Eleven acres of foundry facilities including modern sand handling, mold making and melting equipment, are available for producing castings. In addtion to metallurgical laboratory facilities for physical and chemical analysis, Newport News is equipped with Gamma-Ray, Radiograph and Magnaflux equipment to assure thorough inspection of foundry products.

Your inquiries for stainless steel, iron, steel and brass castings will receive prompt attention.

NEWPORT NEWS

Shipbuilding and Drydock Company

Newport News, Virginia



● Your needs for catalysts for your chemical process can be met in full through the experience, knowledge and facilities of Davison Chemical. Davison not only produces standard catalysts, but also operates a custom catalyst plant and will design and supply *exactly* the material *you* need. This work of development and production is undertaken by Davison in close collaboration with you, and in strict confidence. Whatever your poundage requirements, and whether you need granules, pellets or powder, you can solve your catalyst problems economically by taking advantage of the knowledge of our Technical Service Department and of the high skill and complete facilities of our Custom Catalyst Plant.

Progress through Chemistry

THE DAVISON CHEMICAL CORPORATION

Baltimore 3, Maryland

Producers of: SILICA GEL, CATALYSTS, SILICOFLUORIDES, CASTING COMPOUNDS, ALUM, INORGANIC ACIDS, FERTILIZER MATERIALS



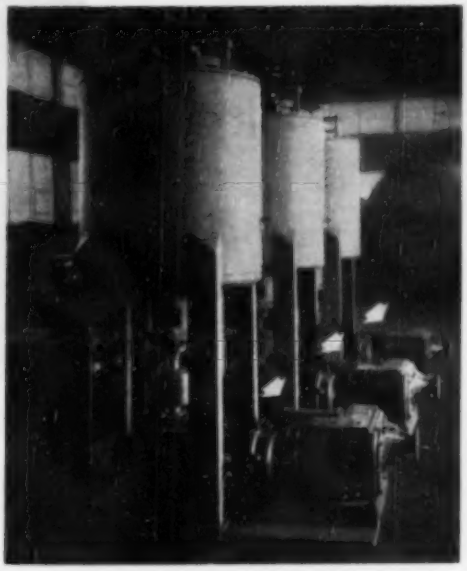
Example: Compensate for changes in material consistency

For your agitators, churns or other processing machines handling materials which change in consistency, density or viscosity, accurate, positive, infinitely variable REEVES Speed Control is a *must*.

Providing machine speeds which can be increased or decreased to the fraction of an rpm as the product thins or thickens, REEVES Speed Control assures continuous operation—without shut-downs or slow-downs for changing speeds—at the fastest possible pace. Rate of production goes up . . . quality is improved and always uniform . . . cost goes down.

REEVES Variable Speed Drives are easily and economically applied to machines already in service . . . are standard equipment on more than 2,100 different makes of new machines. Investigate REEVES right away. Choose from the most complete line of speed control equipment available *anywhere* . . . your assurance of obtaining the units that are *exactly* right for your particular machines and your particular speed control problem. Write for *free* copy of comprehensive, 132-page catalog CE47-3N.





Churns for rubber cement: Illustrated here is a typical application wherein REEVES Speed Control is used to compensate for changes in consistency, density and viscosity. Each of these three churns is standardly equipped with a REEVES Vari-Speed Motodrive, as shown in right foreground. At the beginning of the batch, the agitator paddle turns at its fastest rate of speed. As more rubber is admitted to the churn, mixing with the liquid vehicle, the solution becomes thicker and the speed of the churn must be decreased until the final maximum density of the solution has been obtained. Use of the REEVES Motodrive permits the churn to be operated at high speed while the solution is thin, thus accomplishing a higher rate of production than if paddle had turned at a slow, fixed speed, as determined by the maximum density of the mixture. With variable speed, therefore, the operating speed of the churn is not dependent upon the minimum, but upon the maximum speed for the changing density. For other production-increasing, cost-cutting functions which can best be performed by REEVES Speed Control, see the listing below.

REEVES PULLEY COMPANY • COLUMBUS, INDIANA

Recognized Leader in the Specialized Field of Speed Control Engineering

accurate • variable
REEVES *Speed Control*

Other Uses:

Handle more shapes, sizes and materials • Match skills of operators • Assure accurate timing • Maintain uniform peripheral speeds • Maintain uniform pressure, temperature, liquid level, etc. • Regulate conveyor speeds • Synchronize parts of one machine or different machines operating in series.

more and better service from

R·P&C VALVES

















...here's One Reason Why:



Over 60 years ago, a PRATT & CADY Board of Directors passed this resolution:

Resolved:

"That the superintendent
"shall be held responsible
"for the production of goods
"as near perfect in design,
"material and workmanship
"as shall make them merchantable
"and of a character that will serve
"to establish for this company
"a high reputation."

• This policy has remained unshaken through two world wars. The "high reputation" has been maintained. More than ever before, the valves offered by R·P&C meet the demand for longer and better service.

ACCO

R-P & C VALVE DIVISION
AMERICAN CHAIN & CABLE

READING-PRATT & CADY VALVES

Piccolyte PAGEANT

Pick Any One..



and you get them all

Even if you select only *pale color* as the Piccolyte virtue you want, you will find that the other inherent advantages of this versatile synethic resin provide many practical benefits. Stability, low-cost, compatibility with other materials, chemical inertness, petroleum-solubility are but a few of the features that you can use to improve your products and reduce your costs.

Piccolyte is economical, and easy to use. It is available in nine grades, from soft to hard, horny. Write for a generous test sample, and describe your application so that we can send a suitable grade.



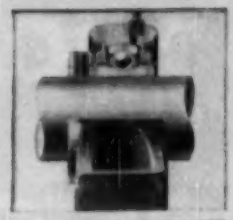
PENNSYLVANIA INDUSTRIAL CHEMICAL CORP.

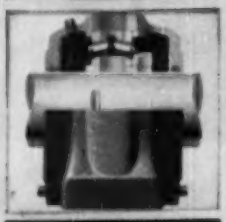
Clairton, Pennsylvania

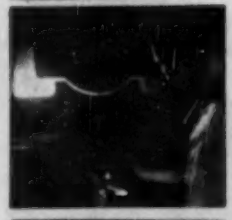
Plants at Clairton, Pa.; West Elizabeth, Pa.; and Chester, Pa.

Distributed by Pennsylvania Salt Chemical Co., Pittsburgh 30, Pa. and Harwick Standard Chemical Co., Akron 5, Ohio

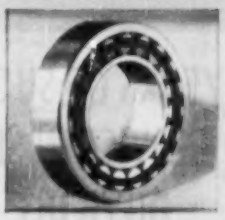
Do You have all these . . . in your bearing specifications?











secure locking

Lock a Link-Belt Ball or Roller Bearing to your shaft . . . without distortion • with firm grip • without mislocation • regardless of rotation • with wide distribution of bearing load

housing seals

LINK-BELT Ball and Roller Bearings are "housing sealed" completely . . . to assure free aligning action • to keep out dirt and moisture • to reduce wear under most severe conditions

outstanding manufacture

even by the strict standards of Ball and Roller Bearing manufacture, LINK-BELT is outstanding . . . because of the most modern precision production • because of quality control

serviceability

install LINK-BELT Ball and Roller Bearings and . . . *let 'em roll* . . .
- they are pre-lubricated • they have a large grease reservoir
- they have correct lubrication

product enhancement

gain these advantages from LINK-BELT Bearings in your product:
- dependability • alignability • high capacities
- interchangeability • quality • LINK-BELT service

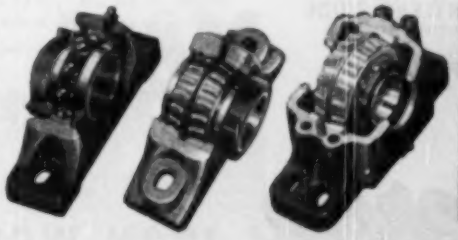
a bearing for every purpose

there is a LINK-BELT Ball or Roller Bearing for . . *every* . . purpose.

An experienced LINK-BELT bearing engineer will go over your bearing requirements with you and make recommendations, without obligation. Send for the complete new LINK-BELT Ball and Roller Bearing Catalog No. 2550.

LINK-BELT COMPANY Indianapolis 6, Chicago 9, Philadelphia 40, Atlanta, Minneapolis 5, Houston 1, San Francisco 24, Los Angeles 33, Seattle 4, Toronto 8, Johannesburg. Offices, Factory Branch Stores and Distributors in Principal Cities.

A complete line of bearings is available from stock, throughout the country, in pillow blocks, cartridge, flanged cartridge, flanged, hanger and takeup blocks —also unmounted bearings.

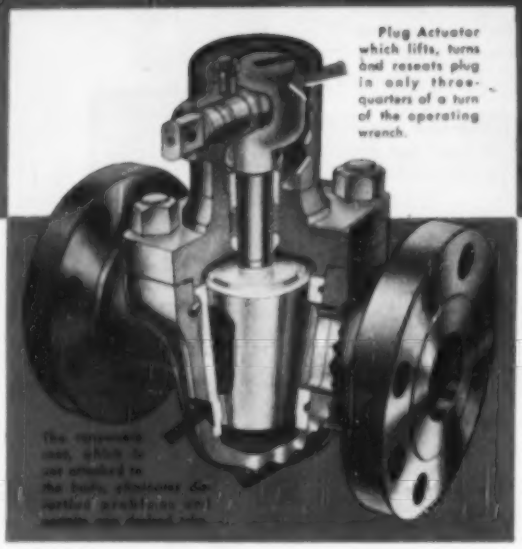


LINK-BELT

BALL & ROLLER

BEARINGS

Specifically Designed for your Service



Plug Actuator which lifts, turns and reseats plug in only three-quarters of a turn of the operating wrench.

Cameron

NON-LUBRICATED

LIFT-PLUG VALVE

YEARS OF SUCCESSFUL SERVICE IN SELECTED DIFFICULT JOBS

- √ CHLORINE
- √ CAUSTIC
- √ L P G
- √ SULPHURIC ACID
- √ HYDROFLUORIC ACID
- √ DOCTOR SOLUTION
- √ ETHYLENE OXIDE

AND OTHER CORROSIVE PRODUCTS

NON-LUBRICATED — no grease of any kind required to effect a seal; prevents contamination of line products, and reduces chance for human error and need for maintenance.

PRESSURE SEALING — when plug is seated, line pressure automatically forces seat into tighter engagement with plug — body distortions do not affect the seal.

UNIQUE LIFT-PLUG ACTUATOR — a novel mechanical design which lifts, turns and reseats plug in continuous turn of a lever.

RENEWABLE SEAT AND PLUG — easily replaced; permits any desired trim for specific services.

REPAIRS ON THE JOB — can be completely overhauled without removal from line; no special tools or skill required.

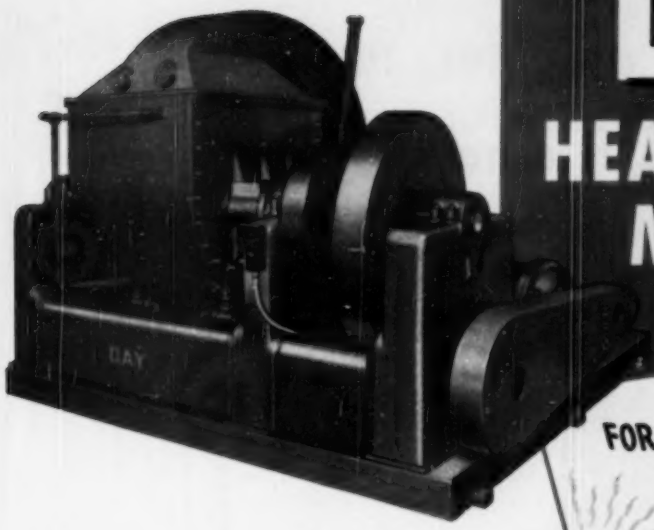
EASY OPERATION — requires less operating effort than other valve designs.

FORGED STEEL — all parts, including body for most sizes, are press or drop forged from specification materials.

Cameron IRON WORKS, INC.

P. O. BOX 1212 • HOUSTON, TEXAS

EXPORT: 74 TRINITY PLACE, NEW YORK, N. Y.



DAY
HEAVY DUTY MIXERS

FOR DAY-IN, DAY-OUT *Dependability*

Perfect control of production is vital to quality output. Day-in and day-out, you can count on DAY Heavy Duty Mixers for consistent performance in processing pastes, semi-pastes and plastic products. They are available with or without vacuum features.

FRAME is heavy cast iron with spread ties closely keyed and bolted to match the strength of one-piece construction.

JACKETED TANK is built to withstand pressure of 100 pounds per square inch. Agitator shaft is special heat treated alloy steel. A dump screw insures positive tilting action.

COVER can be flat, vaulted or vacuum type construction, hinged at rear and perfectly aligned with the tank. Electric interlocking prevents dumping when the cover is in mixing position. Pneumatic or hydraulic cylinder for operating the vacuum cover.

BEARINGS are double-row, roller type, oversized to withstand emergency overloads. Helical cut gears insure quiet operation. Gear drive for dumping mechanism is fully enclosed and runs in oil.

Let your J. H. Day Sales Engineer show you the advantages of DAY Cincinnatus Mixers. Or write direct to The J. H. Day Co., Inc., 1147 Harrison Ave., Cincinnati 22, Ohio.

THE J. H. DAY COMPANY
INCORPORATED
CINCINNATI 22, OHIO



QUA-FLEX STAYS LEAK-PROOF... FITS MOST TYPES OF RACKS AND REELS

Here's a fire hose that defies leakage. Its rubber lining remains resilient and resists cracking. Qua-Flex dries quickly . . . packs compactly . . . is flat folding and easy to handle.

Qua-Flex is more flexible and weighs less than ordinary fire hose, yet it's guaranteed to withstand a test pressure of 300 lbs. p.s.i. Qua-Flex's flat-folding qualities eliminate bulky folds allowing racks and reels to carry greater footage without additional bulk. Qua-Flex's 1½" size has Factory Mutual approval. Available in 1½", and 2½" sizes; 25', 50', 75', and 100' lengths.

Equally outstanding for fire fighting is Quaker Firefite—a single or double jacket, cotton rubber lined fire hose. Firefite meets the Underwriters' specifications and is ideal for high pressure, heavy duty fire protection service where severe usage can be expected and a quality fire hose is paramount.

Specify Quaker Fire Hose for extra long life and easier handling.

For full information on the complete range of sizes and types of Quaker Fire Hose available, write for Bulletin 64.

BELTING FOR MAXIMUM HORSEPOWER

Flat belts or V-belts, Quaker has the one to fit the drive . . . to transmit maximum horsepower at the lowest operating cost . . . all pre-tested for peak performance.



HOSE FOR RUGGED WEAR

Hose for air, steam, water, oil, gas, fire or chemicals . . . Quaker makes it and makes it to fit the needs of Industry . . . each pre-tested for greatest efficiency.



QUAKER RUBBER CORPORATION • PHILADELPHIA 24, PA.

Division of H. K. Porter Company, Inc.

Pittsburgh 22 • New York 7 • Cleveland 14 • Chicago 16 • Houston 1 • Atlanta • Boston

Western Territory:

QUAKER PACIFIC RUBBER CO. • San Francisco 10 • Los Angeles 21 • Seattle 4

QUAKER RUBBER PRODUCTS

custom made for every industrial use

"All motors are NOT alike!"

Check these 15 Reasons Why the RELIANCE Bearing Design is *the BEST one!*

ONLY ONE MOTOR HAS ALL THESE DESIGN FEATURES:	DESIGN A Prelubricated cartridge—bearing mounted in bracket	DESIGN B Open bearing mounted in bracket	RELIANCE Double-shielded, prelubricated bearing mounted in bearing cap
Bearing sealed from dirt and other foreign material	YES	NO	YES
Enclosed bearing housing	NO	YES	YES
Bearing can be re-lubricated without being disassembled	NO	YES	YES
Motor can be re-greased without removing drain plug	**	NO	YES
Automatic grease relief to suit *any* lubrication system	NO	NO	YES
Protection against grease entering windings	YES	*YES	YES
Balls free of direct pressure during lubrication	YES	NO	YES
Bearing can be removed without danger of distortion	NO	NO	YES
Reservoir to protect against under-greasing	NO	YES	YES
Standard commercial ball bearings	YES	YES	YES
Larger grease reserve than provided with any standard bearing	NO	YES	YES
Grease supply free of churning action	NO	NO	YES
Measuring unnecessary to prevent overgreasing	NO	*YES	YES
Unnecessary to grease equally at each side of ball race	NO	YES	YES
Lubricant is retained in ball race	YES	NO	YES

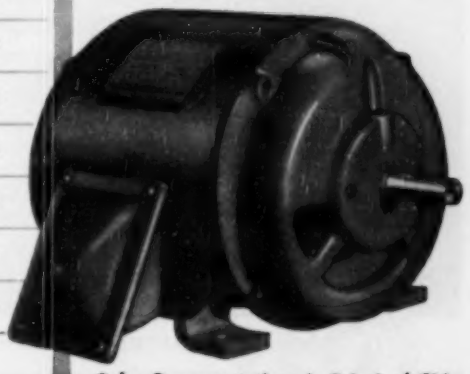
** Means is not provided for relubrication of assembled motor.
*YES, if drain plug is removed.

The Reliance Pre-lubricated Bearing Design has all of the features vital to maximum motor life. Check these points in the chart at left. The performance of Reliance PRECISION-BUILT Motors in all industries and under all operating conditions has proved their value in long-wearing, trouble-free bearing design.

In most applications, Reliance PRECISION-BUILT Motors operate satisfactorily for years without relubrication. Where it is a practice to grease regularly or where operating conditions make it desirable . . . it is impossible to overgrease a Reliance Motor. Write for *new* Bulletin B-2201 for the "inside story" of the Reliance Pre-lubricated Bearing Design.



Reliance PRECISION-BUILT A-c. Motors from ¼ to 300 Hp.



Sales Representatives in Principal Cities

RELIANCE ELECTRIC AND ENGINEERING CO.

"All Motors are NOT Alike" • 1062 Ivanhoe Road, Cleveland 10, Ohio

A STEAM TRAP CASTS A MIGHTY BIG SHADOW!



● **LOAD ON BOILER CUT BY 75 HP** by trapping with Armstrongs, says Chief Engineer of large midwestern hospital.

● **30°-40° TEMPERATURE INCREASE** on 8-roll ironer after unit trapping with Armstrongs, reports large eastern laundry.

● **STARCH DRYER HEAT-UP TIME CUT 2-3 HOURS** after retrapping with Armstrongs, says Canadian plant engineer.

● **125 HP BOILER NOT NEEDED** — 80 HP boiler does the job since Armstrong traps were installed in a chemical plant in Iowa.

● **50% SAVINGS IN TRAP MAINTENANCE LABOR COSTS** since installing Armstrongs at midwest agriculture machinery plant.

● **COOKING KETTLE OUTPUT SPEEDED UP 30%** by Armstrong unit trapping at large canning plant.

. . . BIG EFFECTS from little traps! The "shadow" cast by a steam trap is multiplied in size by the number of traps in your plant until it grows to be a giant that you can't shrug off. Let your nearby Armstrong Representative show you how Armstrong Trapping can cut *your* fuel, production and maintenance costs. Call him today.

Write for STEAM TRAP BOOK —
36 pages of useful, how-to-do-it data. Free on request.

ARMSTRONG MACHINE WORKS 858 Maple Street, Three Rivers, Michigan

ARMSTRONG STEAM TRAPS

The Emulsion Technologist ...like the Gaucho... needs the RIGHT TOOL for a particular job!





EMULSION technologists, like the cowboys of the pampas, need exactly the right tools to make the most of their skill. The gaucho uses his *bolas* to entangle the legs of the swift ostrich. The chemist needs exactly the right emulsifier to mix oil and water or to perform some other function such as wetting or dispersing, penetrating or cleaning. With dozens of emulsifiers to choose from, picking the ideal is not always simple.

To assist the chemist in finding the *right* tool—the *right* emulsifier—for a particular job, Atlas evolved the HLB System of selecting emulsifiers. The HLB System, first of its kind, is based on the Hydrophile-Lipophile Balance of each emulsifier and saves a lot of tedious experimentation.

Atlas makes scores of surface active agents, including the well-known SPAN, TWEEN, ARLACEL, MYRJ, BRIJ, and ATLOX emulsifiers, to fit the particular requirements of a host of different emulsifying, spreading, detergent, and penetrating applications. And we can build *special* emulsifiers to fit a specific need. Why not let us help with *your* emulsifier problems? Write for new booklet showing latest developments in the HLB System of selection.

ATLAS CHEMMUNIQUÉ

Solid Polyester Binders Do Not Discolor

Atlas research has developed new solid polyester resins for binding fibers into desired shapes. The solid form, which contains a catalyst, means complete stability in storage, and the new resins do not discolor on curing. They give excellent wetting action, too, promoting better strength of finished articles made from low-pressure polyester laminating resins. Ask for further information re solid polyesters for laminating as well as binding.

This Might Ease Polyol Shortage for You

Atlas G-2340 polyoxyethylene glucose helps ease the polyol shortage in many non-food uses such as moisture conditioning of fibers, cork compositions, gaskets, leather and paper. It is a water-white, water-soluble liquid, similar to Arlex* commercial sorbitol solution in humectant properties, but less viscous than glycerin. Compatible with sorbitol, glycerin, propylene glycol and other polyols, it is used as an extender for these in many applications.

PYCAL Plasticizers Cut Polyvinyl Film Costs

Two of the Atlas newly-christened PYCAL* plasticizer series show outstanding properties as secondary plasticizers for polyvinyl chloride compositions. Improved heat stability, better colors, better cold temperature flex, and savings in use of primary plasticizers are shown. Ask for data on PYCAL 70 and PYCAL 76.

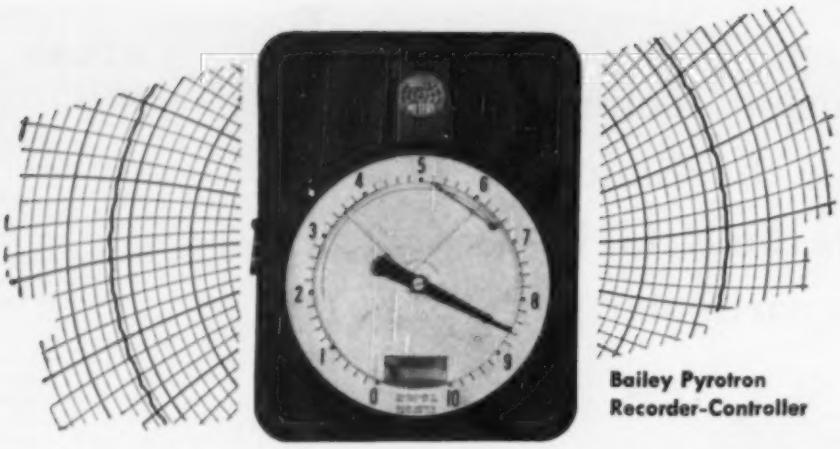
*Reg. U. S. Pat. Off.

SPAN, TWEEN, ARLACEL, MYRJ, BRIJ, ATLOX—Reg. U. S. Pat. Off.

ATLAS INDUSTRIAL CHEMICALS DEPARTMENT

CHEMICALS ATLAS EXPLOSIVES

ATLAS POWDER COMPANY, Wilmington 99, Del. • *Offices in principal cities* • *Cable Address—Atpowco*
ATLAS POWDER COMPANY, CANADA, LTD., Brantford, Canada



Bailey Pyrotron
Recorder-Controller

Looking for Better Temperature Instruments?

...Then check these features of Pyrotron Electronic Resistance Thermometers...

FUNDAMENTAL ACCURACY

Bailey Pyrotron Resistance Elements are made of highest purity platinum—the material used by the National Bureau of Standards in establishing basic standards for temperatures from −190°C to +660°C.

THREE TYPES OF CONTROL

Pyrotron Controllers may operate: on-off electrical systems by either electronic relays or electric contacts, modulated electronic systems, or air-operated systems. Two temperatures may be recorded on the same chart and controlled by a single instrument.

FACTS PUT INTO USABLE FORM

Bailey Pyrotrons may be arranged to put temperature facts into convenient usable forms. If two or more temperatures are related, they may be recorded as continuous records on the same chart for easy comparison. The average of several temperatures or the difference between two temperatures may be recorded as a single continuous record which may be retransmitted to a distant point or used to actuate a control system.

EASY INSTALLATION

Bailey Pyrotrons do not require careful leveling or protection against vibration. Three ordinary copper wires are all that is needed to connect each temperature sensitive element with the recorder. Power may be taken from any 115 volt 60 cycle circuit.

MINIMUM MAINTENANCE

The absence of galvanometers, batteries and standardizing equipment, together with the use of interchangeable unit assemblies, reduces Pyrotron maintenance to the vanishing point.

ABUNDANT POWER

A separate motor drive for each temperature furnishes abundant power to operate a recording pen, a controller and an alarm switch.

For the full story on this unusual electronic resistance thermometer which is suitable for ranges between −300°F and 1200°F, ask for Bulletin No. 230-C. P-21

BAILEY METER COMPANY

1054 IVANHOE ROAD • • • CLEVELAND 10, OHIO

Controls for Processing

TEMPERATURE FLOW
PRESSURE LEVEL
% OXYGEN DENSITY
% COMBUSTION RATIO

OUR CUSTOMER LIST KEEPS ON GROWING

And well it might! The word gets around that A.C.F. has the equipment, the techniques and the resources to shoulder a major responsibility, and deliver the goods. The shops are tooled for hand and machine-welding under precision control, for X-ray inspection as required, and with the personal skills and experience of as expert a staff as exists anywhere. We'd be delighted to discuss adding your firm name to the customer list. Write for literature.

a.c.f.
FABRICATION



American Car and Foundry Company, Tank and Pressure Vessel Department, 30 Church Street, New York 8, N. Y.
Sales Offices also in: Chicago · St. Louis · Cleveland · Philadelphia · Washington · Pittsburgh · San Francisco



It's the Nash!

There are no mechanical complications in a Nash Compressor. A single moving element, a round rotor, with shrouded blades, forming a series of buckets, revolves freely in an elliptical casing containing any low viscosity liquid. This liquid, carried with the rotor, follows the elliptical contour of the casing.

The moving liquid therefore recedes from the rotor buckets at the wide part of the ellipse, permitting the buckets to fill with gas from the stationary Inlet Ports. As the casing narrows, the liquid is forced back into the rotor buckets, compressing the gas, and delivering it through the fixed Outlet Ports.

Nash Compressors produce 75 lbs. pressure in a single stage, with capacities to 6 million cu. ft. per day in a single structure. Since compression is secured by an entirely different principle, gas pumping problems difficult with ordinary pumps are often handled easily in a Nash.

Nash simplicity means low maintenance cost, with original pump performance constant over long periods. Data on these pumps sent immediately on request.

- No internal wearing parts.
- No valves, pistons, or vanes.
- No internal lubrication.
- Low maintenance cost.
- Saves floor space.
- Desired delivery temperature automatically maintained.
- Slugs of liquid entering pump will do no harm.
- 75 pounds in a single stage.

NASH ENGINEERING COMPANY
325 WILSON, SO. NORWALK, CONN.

When you're looking for

LEAD-LINED EQUIPMENT

that can stand the acid test



Lead-lined or lead-covered equipment for handling corrosive chemicals has maximum life when it's "Homogeneous" equipment made by National Lead.

In "Homogeneous" equipment, the lead lining is inseparably *bonded* (not *loose-lined*) to the metal of which the apparatus is constructed. The bonding is accomplished by applying the lead directly to this metal without use of tin or tin-lead solders.

The "Homogeneous" process of bonding gives you positive assurance that the lead will not creep, buckle, or lose its grip. Despite shock, vibration, vacuum, pressure or high temperatures, that bond will hold. In fact, the bond will not be broken unless heat is applied closely approaching the melting point of lead itself (620°F.).

All of National Lead's "Homogeneous" Lead-lined or Lead-covered Equipment is individually fabricated to your specifications.

Our Engineering Department will be glad to discuss the value of "Homogeneous" lead-lined or lead-covered protection for acid cars, trailer tanks, acid columns, agitators, autoclaves, digesters, heat exchangers, vacuum tanks, storage tanks, propellers, heating and cooling coils. Consult with these specialists whenever you need processing equipment that's built to stand the acid test.

...look to the Leader in Lead

...in everything from lead pipe...valves...sheet...and lead-lined or lead-covered equipment...to complete acid recovery plants.

NATIONAL

LEAD COMPANY

New York 6; Atlanta; Baltimore 3; Buffalo 3; Chicago 8; Cincinnati 3; Cleveland 13; Philadelphia 25; Pittsburgh 12; St. Louis 1; Boston 6 (National Lead Company of Mass.); Los Angeles 23 (Morris P. Kirk & Son, Inc.); Toronto, Canada (Canada Metal Co. Ltd.).

Dutch Boy PRODUCTS

Reg. U. S. Pat. Off.

JETS GET FLEXIBILITY JOB SPEEDS AHEAD

PENFLEX FLEXIBLE METAL HOSE PROVIDES EFFICIENT, TIME SAVING SERVICE AS JET FEEDER LINES ON TUNNEL PROJECT

Down with a 14,000 ton caisson seventy feet into a sand island. Jet feeder lines had to be flexible to transmit water at high pressure up and over the top and down to the jets at the bottom of the caisson.

As the caisson settled, the constant changing of the top level made flexibility a "must" for these jet feeder lines. Penflex "flexineering" had the answer . . . the problem ended.

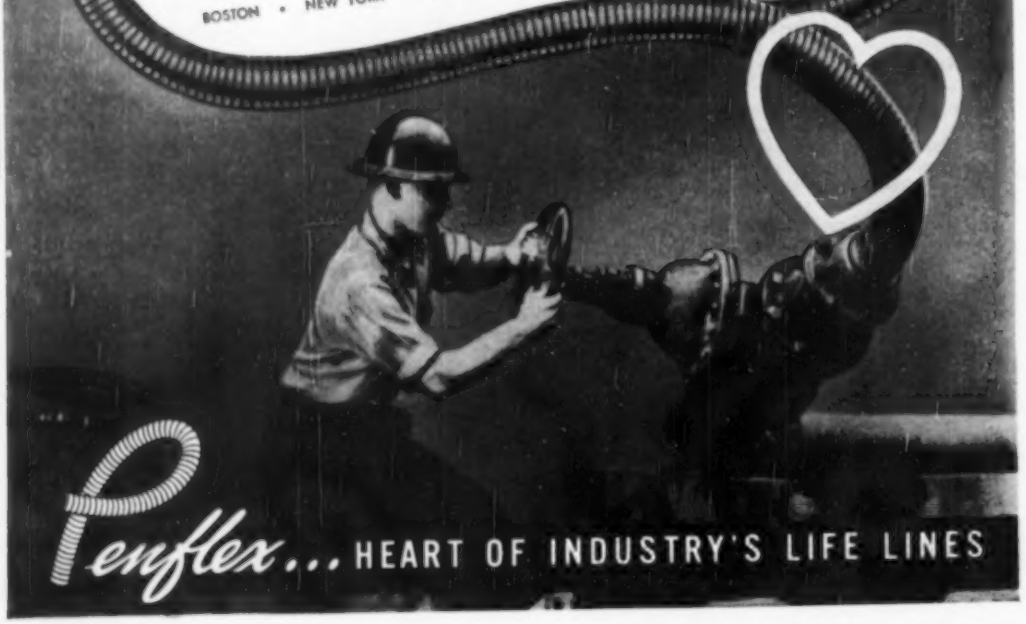
Penflex 4" interlocked, flexible metal hose was installed. Connecting and disconnecting rigid pipes was eliminated . . . time saved . . . labor saved . . . and the job speeded up.

Penflex hose is tough, rugged tubing that is tight as a pipe . . . resists high pressures . . . . yet provides all of the flexibility necessary for the job.

Whether your problem is the transmission of liquids, volatiles, granular material or taking the vibration out of exhaust and air lines . . . or even the protection of fine lead wires on instruments, "flexineering" has the answer for you. Penflex engineers will be glad to work with you in the application of tubing from 1/8 inch I.D. on up to 24 inch I.D. Write today for your copy of "FLEXINEERING."

Pennsylvania Flexible Metallic Tubing Company, Inc.
7234 Powers Lane, Philadelphia 42, Pennsylvania

Branch Sales Offices
BOSTON • NEW YORK • CHICAGO • HOUSTON • CLEVELAND • LOS ANGELES



Penflex... HEART OF INDUSTRY'S LIFE LINES

Chemical and Physical Properties of Fused Alumina Filter Plates



Norton Alundum® porous plates, unaffected by acid, neutral and slightly alkaline liquors, combine uniform porosity with great strength.

Made of fused alumina, fired to at least cone 12, Norton Alundum porous plates are relatively unaffected by acid, neutral and slightly alkaline liquors. The high alumina glass bond may be affected by strong and hot sodium and potassium hydroxides and by hydrofluoric acid. The following table shows the results of solubility tests under exacting conditions with standard 12" x 12" x 1" Norton Alundum porous plates.

SOLUBILITY TESTS

Solution	Strength in Percent	Percent, Cumulative Loss — Same Plate Alternating Hot and Cold: Loss at 10 Days — 75 Hrs. at 85-100° C. 169 Hrs. at 20° C.	Loss at 20 Days — 131 Hrs. at 85-100° C. 349 Hrs. at 20° C.	Loss at 30 Days — 192 Hrs. at 85-100° C. 528 Hrs. at 20° C.
Phosphoric Acid	85.00	.373	.522	.654
Phosphoric Acid	42.50	.290	.362	.394
Sulphuric Acid	96.00	.326	.444	.488
Sulphuric Acid	25.00	.391	.494	.578
Nitric Acid	70.00	.149	.187	.232
Nitric Acid	22.00	.130	.167	.234
Hydrochloric Acid	35.00	.354	.528	.674
Hydrochloric Acid	20.00	.292	.352	.397
Hydrofluoric Acid	.25	.602	.644	.644
Sulphuric Acid / Nitric Acid	1/5 of 96.00 / 1/20 of 70.00	.188	.318	.388
Ammon. Hydroxide	28.00	at 20°C. .046	at 20°C. .057	at 20°C. .062
Sodium Hydroxide	10.00	.937	1.453	2.302
Calcium Hydroxide	Sat. Sol.	at 20°C. .032	at 20°C. .046	at 20°C. .062
Ammonium Chloride	10.00	.041	.053	.076
Zinc Chloride	10.00	.084	.123	.142
Zinc Chloride	5.00	.032	.044	.052

NOTE Only in the case of sodium hydroxide were edges of plates affected. A slight rounding was noticeable as was to be expected.

UNIFORM PERMEABILITY

Because of Norton's patented "Controlled Structure" process, Alundum porous plates meet extremely rigid specifications for uniform permeability. The size and number of open pores determine permeability. The following table gives approximate pore sizes for different porosities and permeabilities. Permeability is given in cubic feet of air passed per minute on a dry plate 12" x 12" x 1" under 2" water pressure.

Permeability	Percent of Pore Space by Volume	Avg. Dia. of Pores
4 cubic feet	36	0.09 mm.
20 cubic feet	35	0.21 mm.
40 cubic feet	34	0.30 mm.

®Trade-Mark Reg. U. S. Pat. Off. and Foreign Countries

GREAT STRENGTH

The following table of tests on standard Alundum 12" x 12" x 1" porous plates of various permeabilities indicates the ability of these plates to operate under high pressures and to resist breakage and chipping due to handling and cleaning.

Average Permeability of Dry Plate, cu ft/min/sq ft/in. thick /at 2 in. Water Pressure	Average Modulus of Rupture, psi: Dry	Wet	Breaking Load when Wet Plate is Supported on Four Sides with ½" Bearing: Ft. of Water	#/sq. in.
121.0	1670	1465	97	42
80.9	1930	1685	110	48
37.8	2684	2235	147	64
16.9	3045	2644	175	76
4.1	3770	3716	246	107



GET BULLETIN 140

All of the foregoing data, as well as detailed installation and cleaning instructions, are contained in a highly informative 16 page bulletin. To get it, contact your nearby Norton representative or write direct. NORTON COMPANY, 501 NEW BOND ST., WORCESTER 6, MASS.

NORTON

TRADE MARK REG. U. S. PAT. OFF.

Making better products to make other products better

Special REFRACTORIES

Canadian Representative

A. P. GREEN FIRE BRICK CO., Ltd. TORONTO, ONTARIO



"triple-threat"
to high packing costs

Weighing and packing finely ground materials needn't be costly. Richardson Automatic Packing System handles these materials so efficiently (and with the cheaper open mouth bags) that in many cases it pays for itself within a year. Here's why:

1. **YOU SAVE ON LABOR** . . . Here are some typical speeds with only one man operation. (When one man packs and another sews the output is almost doubled). 5 bags per minute—50 lb. textile bags. 4 bags per minute—100 lb. textile bags. 4 bags per minute—100 lb. paper bags.
2. **YOU SAVE ON BAGS** . . . Not only does this system use the cheaper open-mouth bags, but its auger packer permits the use of smaller bags by forcing the material into the bag when packing.
3. **YOU SAVE ON MATERIAL** . . . Costly overweights are eliminated (as well as "good-will costing" underweights.)

The Richardson Packing System consists of (1) a Triple Screw Feeder incorporating a two-speed and dribble feed, (2) an Automatic Scale, dust tight, with stainless steel platework contacting the material, (3) an Auger Packer using a motor driven auger to force material into the bag; bag is supported by an air-operated bagholder; packing pressure is adjustable and (4) a V-Belt Sewing Conveyor to allow any spilled material from defective bags to fall through the spaces between the belts; limit switch stops bag at sewing pedestal.

Consulting a Richardson engineer on *your packing problem* puts you under no obligation—it may lead to major savings in your packing operations. Bulletin No. 3449 gives complete information.



Richardson

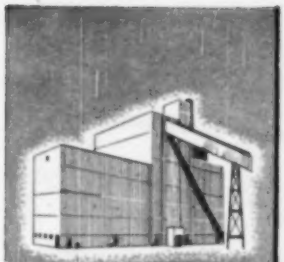
MATERIALS HANDLING BY WEIGHT SINCE 1902

RICHARDSON SCALE COMPANY

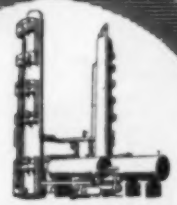
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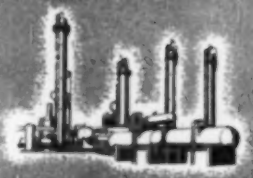
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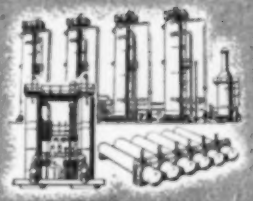
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DESIGN ENGINEERING and CONSTRUCTION for INDUSTRY

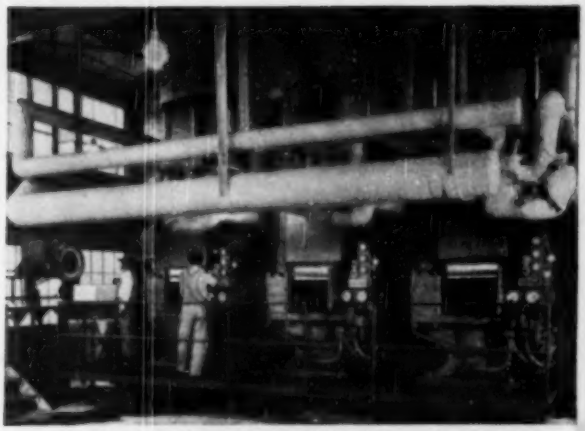


Photo shows three semi-automatic dry ice presses turning out 200 lb. blocks of dry ice in a well known midwestern plant designed and engineered by Pritchard.

Pritchard-Built Plants— *OUTSTANDING* in the Industry

Pritchard-built "dry-ice" and liquid CO_2 plants are *outstanding* for their low cost, operating efficiency and production to the *exacting* quality standards set by the purchaser.

But "dry-ice" plants are only one of many types which Pritchard builds for the chemical industries. Our wealth of technical "know-how" and experience acquired through the years are your guarantee of an *outstanding* plant whenever Pritchard's services are utilized.

Whether you need complete "turnkey" service to include processing, design, engineering, procurement and construction—or whether you desire merely to supplement the work of your own engineering staff, Pritchard's services are *flexible* to provide assistance and close cooperation in whatever degree your project may require.

Call in a Pritchard engineer when you plan your next project. Let him show you how to make it one of the *outstanding* in the industry!

Write for Catalog 0.94.001

NATIONAL CONSTRUCTORS ASSOCIATION MEMBER

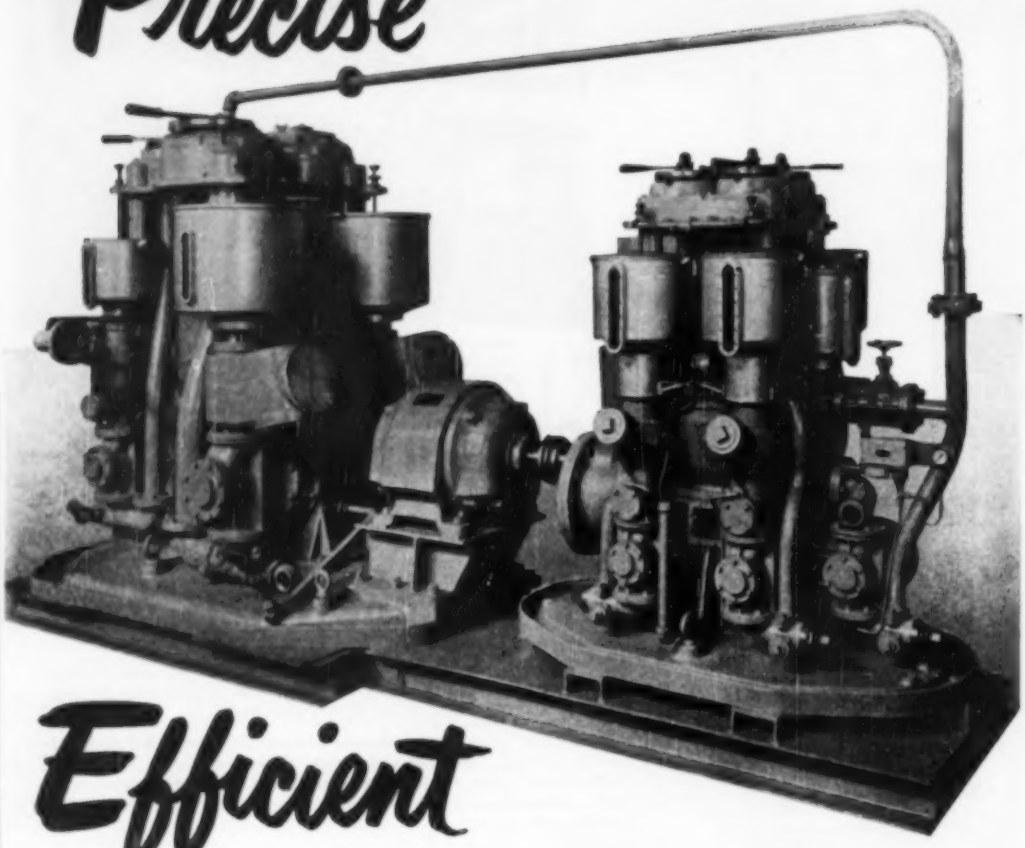
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DESIGN • ENGINEERING • CONSTRUCTION

Dept. No. 96 908 Grand Ave., Kansas City 6, Mo.

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Precise



Efficient

The oil blending machines shown here are examples of the precise and efficient craftsmanship available at Sun Ship. The versatility of our organization and the diversity of our facilities enable us to build with equal success other refinery equipment, chemical plant and industrial machinery; tankers, cargo and passenger vessels. Here, too, are facilities for dry docking and for making all kinds of marine repairs.

Sun

SHIPBUILDING & DRY DOCK COMPANY

ON THE DELAWARE CHESTER, PA.

25 BROADWAY • NEW YORK CITY

Sparkler Horizontal Plate Filters

. . . have high flow rates

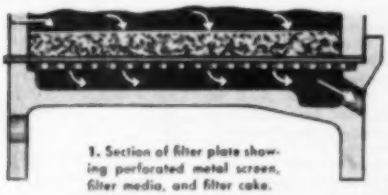
Frequently two to five times as high as the flow through filter septa lying in a different plane.

In Sparkler filters, friction encountered in high flow and high viscosity operations is reduced to a negligible factor by the free drainage and uniformity of cake provided only by Sparkler's horizontal plate construction. Less operating pressure is needed, with the result that the cake is less dense and thus offers less resistance to flow.

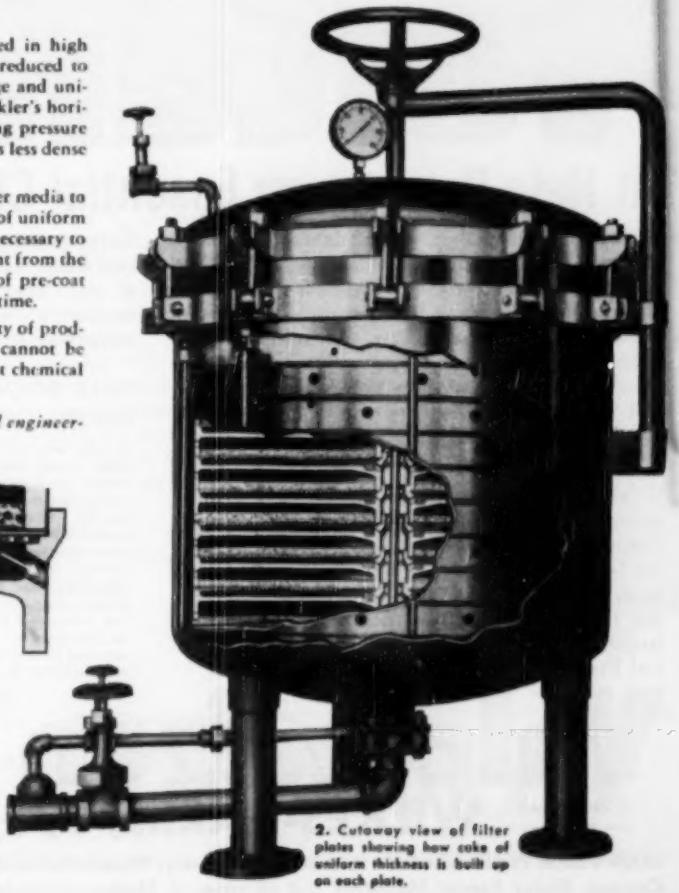
Sparkler horizontal plates permit filter media to be floated into position forming a cake of uniform thickness. Only a thin pre-coat cake is necessary to assure brilliant clarity of the filtrate right from the start. This means maximum economy of pre-coat material and precoating recirculating time.

For all out economy, speed and quality of product Sparkler Horizontal Plate Filters cannot be matched by other types in filtering most chemical products.

Write Mr. Eric Anderson for personal engineering service on your filtering problem.



1. Section of filter plate showing perforated metal screen, filter media, and filter cake.

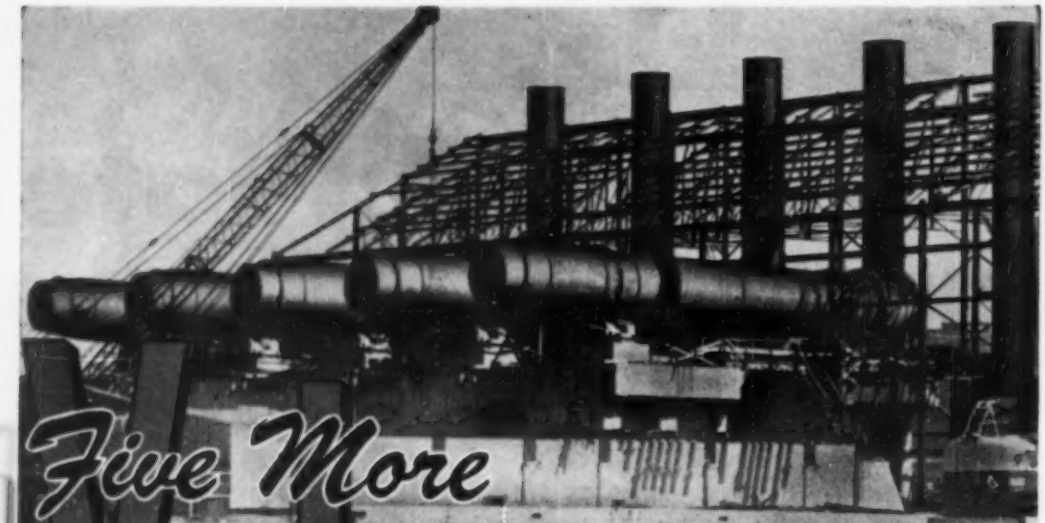


2. Cutaway view of filter plates showing how cake of uniform thickness is built up on each plate.

SPARKLER MANUFACTURING COMPANY

Mundelein, Ill.

Makers of filters for the Chemical, Pharmaceutical, Food and Petroleum Industries for over a quarter of a century.



Five More Vulcan ROTARY KILNS

To Help Produce an Essential Chemical Material

Right Now, when their output is needed more than ever before, these five Vulcan kilns are going into operation at a well-known chemical plant whose product is indispensable to a wide variety of industries. We congratulate the company whose management was far-sighted enough to anticipate the present emergency and we are proud of our part in this important contribution to our country's welfare.

For more than half a century the Vulcan Iron Works has been a leader in the design and manufacture of Rotary Kilns, Coolers, Dryers, Retorts, etc. Throughout all of this long period we have maintained the highest standards of quality—the best evidence of which is found in our list of users; which includes most of the larger companies in the Rock Products, Chemical Processing and Metallurgical industries.

Correspondence is invited regarding any requirement for the calcining, cooling or drying of any inorganic material. Our experienced engineers welcome opportunities to make suggestions without charge or obligation.

THIS BOOKLET MAY SAVE YOU MANY HOURS OF PRECIOUS WORKING TIME

It tells how to keep kilns running when trouble occurs—either permanently or until replacement parts can be secured. Better still, it tells how to PREVENT TROUBLE through proper precautions during installation and by watching out for conditions which may cause trouble if not corrected in time. Free on request to any one who can use it to advantage. Ask for Bulletin No. 380.



Vulcan Iron Works

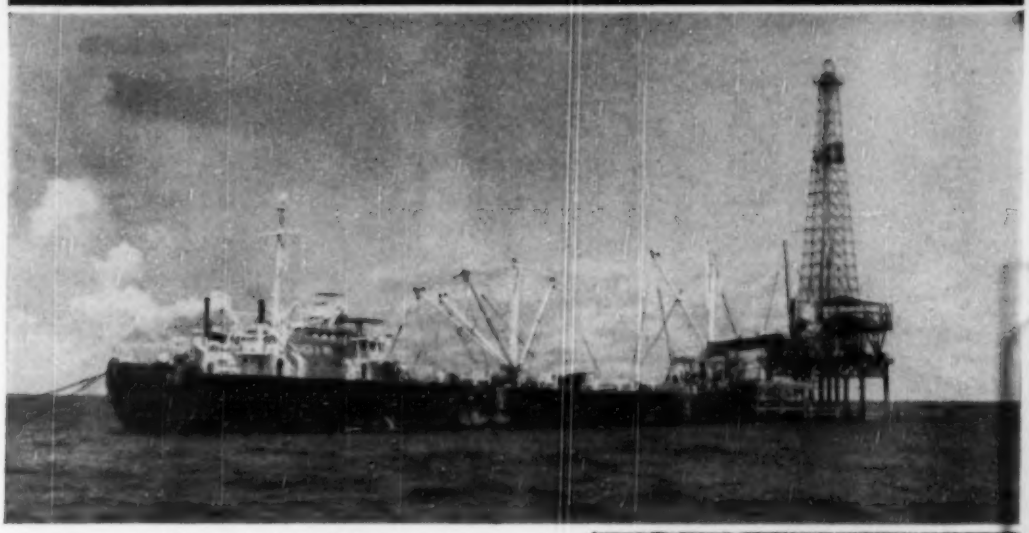
Established 1849

WILKES-BARRE, PA., U.S.A.

Cable Address "Vulworks Wilkes-Barre"

Other Vulcan Products include Briquetting Machinery, Electric Hoists, Mining Machinery, Open Hearth Steel Castings, Heavy Special Machinery and all types of Modern Industrial Locomotives Bulletins on request.

CEMENT STORAGE BINS KEPT DRY BY LECTRODRYER ON OFFSHORE DRILLING RIG



The California Company's S-21 drilling tender.

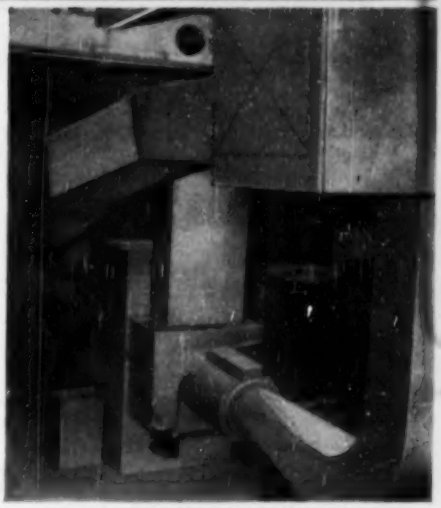
● Because of the extreme dampness over water, extra precautions had to be taken to protect the cement stored on this drilling tender. Lectrodryer eliminates that problem by circulating warm, DRY air through each compartment.

Five cement storage tanks, with a total capacity of 4077 sacks, are served by the Lectrodryer.

This is an unusual application—few men will have need for one like it. But it demonstrates the ability of Lectrodryers and Lectrodryer engineers to handle every kind of DRYing job. It's evidence that there's no need for your engineers to spend time designing special equipment to DRY air, gases or organic liquids when a Lectrodryer has already been built to do it.

For this help, write Pittsburgh Lectrodryer Corporation, 303 32nd Street, Pittsburgh 30, Pennsylvania.

In England: Birlec, Limited, Tyburn Road, Erdington, Birmingham.
In Australia: Birlec, Limited, 51 Parramatta Road, Glebe, Sydney.



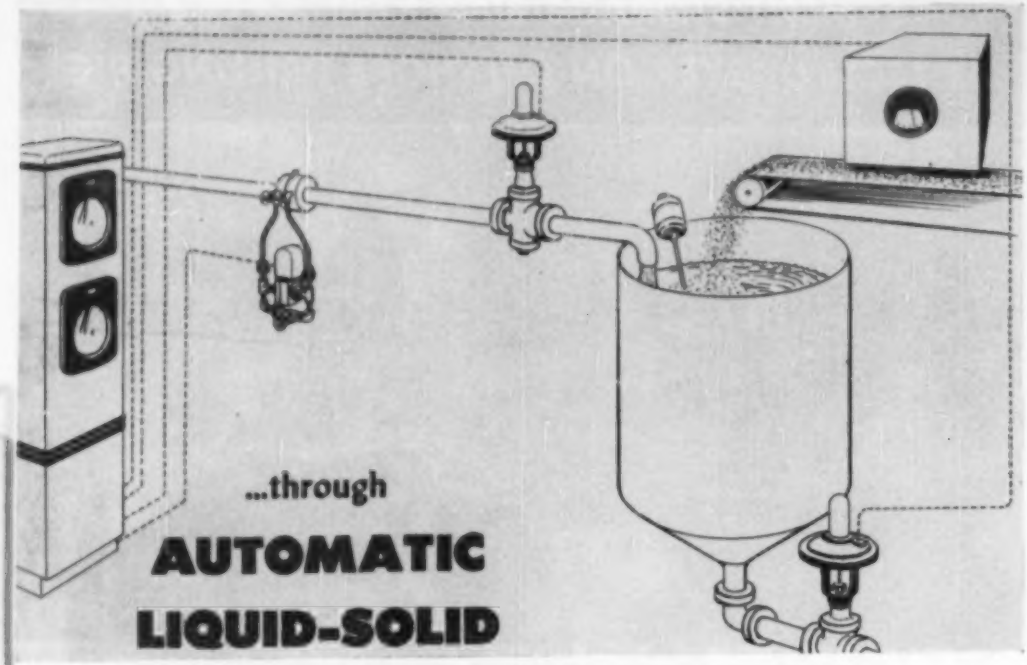
This Lectrodryer feeds DRY air into the bins before and after taking on a load of cement.

LECTRODRYERS DRY WITH ACTIVATED ALUMINAS

LECTRODRYER

REGISTERED TRADEMARK U. S. PAT. OFF.

NEW OPPORTUNITIES in continuous processing



RATIO CONTROL...by Foxboro

Many a troublesome batch process can be converted to continuous operation — with resulting economies and product improvement — by installing Foxboro Liquid-Solid Ratio Control. This simple, accurate system has been thoroughly proved in use on such processes as the extraction, dissolving, or reaction of materials.

Typical examples include the proportioning of acid feed to phosphate rock in the production of phosphate fertilizer, and the proportioning of water to the feed of cossettes (sliced beets) in the production of beet sugar. *Wherever ratio-ing the quantity of liquid reagents to a varying rate of solid chemicals being delivered by a conveyor belt is desirable, this fully automatic system simplifies the operation and improves the efficiency of the process.*

In this system, a Foxboro Recording Controller receives a continuous measurement of weight of the solid material (from a Foxboro Pneumatic Motion Transmitter incorporated in a Merrick Weightometer located above the conveyor belt), and also receives a continuous measurement of liquid flow from a Foxboro d p Cell or mercury manometer. The desired ratio between solid and liquid can be readily set by a dial in the instrument which, in turn, controls the liquid flow.

The efficiency-boosting advantages of Foxboro Ratio Control are now being realized by a number of leading companies. If you have a similar problem, learn how these advantages may be achieved for your plant. Write for engineering data. **The Foxboro Company, 16 Neponset Ave., Foxboro, Mass., U. S. A.**



This illustration shows Foxboro Ratio Control at a large beet sugar plant. A Merrick Weightometer equipped with a Foxboro Pneumatic Motion Transmitter appears in the foreground.

FOXBORO REG. U. S. PAT. OFF. **COORDINATED CONTROL**

The world's fullest market basket naturally takes the shape of America. For that fact thank *industry* – steel mills and textile mills, paper mills and oil wells, machine tool plants and tractor plants, every place where wheels turn and men work. Wheels turn faster and men work more efficiently in *every* industry because of anti-friction bearings. And every industry knows and uses SKF Ball and Roller Bearings. Every industry knows SKF as pioneers. Every industry knows that SKF engineering anticipates their needs for exactly the right bearing to do the job at hand. **SKF** INDUSTRIES, INC., PHILADELPHIA 32, PA., *the Pioneers of the Deep-Groove Ball Bearing, Spherical Roller Bearing, Self-Aligning Ball Bearing.*

7031

HELPING MAP OUT *America's* 276-BILLION DOLLAR MARKET BASKET



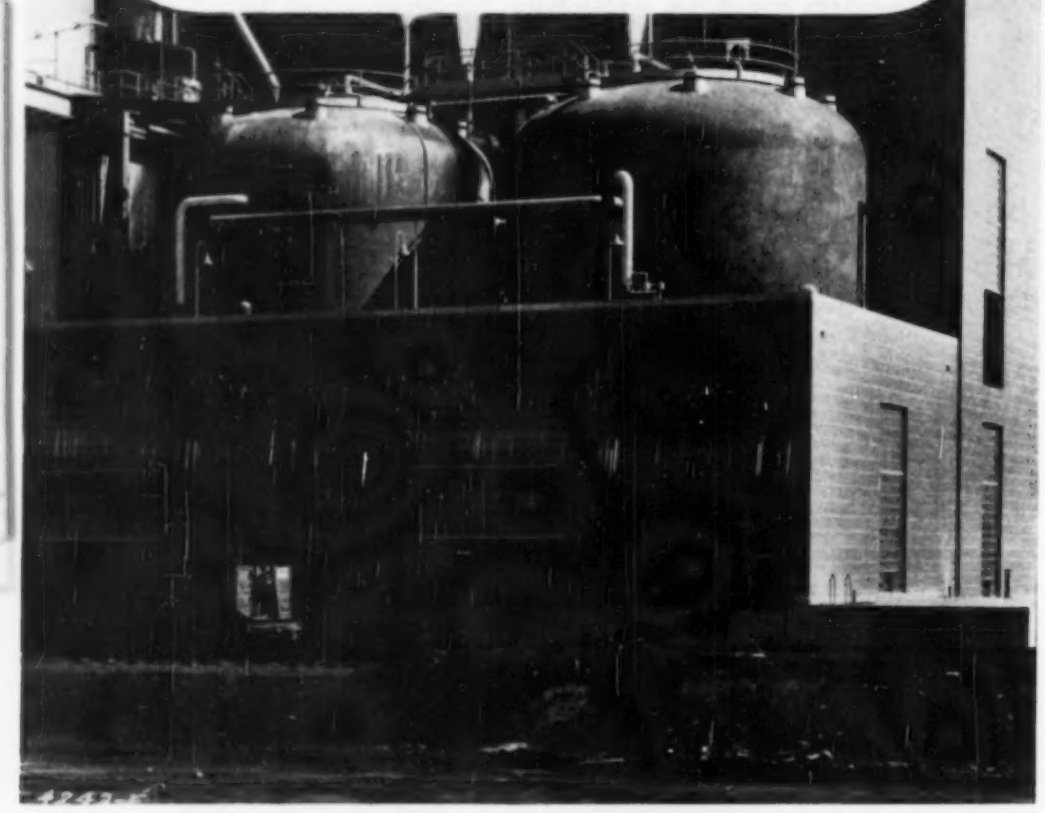
HORTON WELDED STEEL TANKS
AGAIN PROVIDE THE ANSWER

Pushing their heads out of the Corn Products plant at Argo, Illinois, are two new Horton sedimentation tanks. They were installed recently as a part of a two-step water softening unit used to soften boiler feed water which the company takes from the city water mains.

Both steps in the process involve the precipitation of sludge through heating and chemical action. Water entering the first tank is heated to 215° F. and subjected to a lime soda-ash treatment with a sodium aluminate adjunct. This reduces hardness to about 5 to 7 parts per million. The water is then transferred to the second tank where a disodium phosphate treatment reduces the hardness to 1 part per million. Sludge collecting in the bottoms of both tanks is drawn off.

The two tanks, which are identical in shape, hold 185,000 gals. each. Welded steel construction insures leak-proof joints and easy maintenance.

Specialized tank construction for industry has long been standard practice by our engineers and fabricators. Your business can benefit by making use of their knowledge. Write our nearest office for complete information.



CHICAGO BRIDGE & IRON COMPANY

Atlanta 3	2120 Healey Bldg.	Detroit 26	1503 Lafayette Bldg.	Philadelphia 3	1625—1700 Walnut St. Bldg.
Birmingham 1	1510 North Fiftieth St.	Havana	482 Abreu Bldg.	Salt Lake City 4	505 West 17th South St.
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Chicago 4	2124 McCormick Bldg.	Los Angeles 17	1305 General Petroleum Bldg.	Seattle 1	1305 Henry Bldg.
Cleveland 15	2220 Guildhall Bldg.	New York 6	3318—165 Broadway Bldg.	Tulsa 3	1623 Hunt Bldg.

Plants in BIRMINGHAM, CHICAGO, SALT LAKE CITY and GREENVILLE, PENNSYLVANIA



PC Foamglas insulates this typical equipment used in the manufacture of penicillin, where temperatures range from 0°F. to 260°F. This efficient, long lasting insulation is available in standard flat blocks, curved segments and beveled legs to fit equipment sides, heads and domes, and in preformed sections for standard pipe sizes and fittings.

CUT DOWN INSULATION UPKEEP

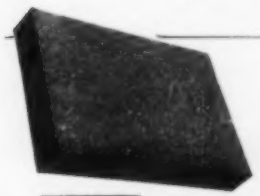
with PC FOAMGLAS—the long life insulation

● It takes a mighty *effective* insulation to keep refineries and other processing plants running effectively. And it takes a mighty *economical* insulation to keep them running economically. That is why so many engineers are installing PC Foamglas on indoor and outdoor piping, on tanks, towers and other processing equipment.

Its cellular glass structure makes PC Foamglas an effective insulation. Millions of minute sealed glass cells form an excellent barrier to heat travel, thus help to maintain desired temperatures, to minimize condensation.

Then too, being glass, Foamglas has unusually high resistance to moisture, vapor, acid atmospheres, and other elements that cause some materials to lose insulating efficiency. It is noncombustible, odorless and verminproof, has high compressive strength. Consequent freedom from costly repairs, maintenance and replacement makes PC Foamglas a truly economical insulating material.

It will pay you to know all the advantages you get with PC Foamglas. Our specialists will be glad to consult with you regarding your individual insulating problems. Our literature will give you complete information and specifications on the usual applications of Foamglas. Send in the convenient coupon today. Your free copies of this illustrated, informative booklet—and a sample of the material—will be mailed to you promptly.



This is FOAMGLAS®

The entire strong, rigid block is composed of millions of sealed glass bubbles. They form a continuous structure which has unusually high resistance to moisture, vapor and acid atmospheres, is noncombustible, verminproof and odorless. In those closed glass cells, which contain still air, lies the secret of the material's long life insulating efficiency.

Pittsburgh Corning Corporation
Dept. B-110, 807 Fourth Avenue
Pittsburgh 22, Pa.

Please send me without obligation, a sample of Foamglas and your free booklet on the use of PC Foamglas for Industrial Insulation.

Name.....

Address.....

City.....State.....

PITTSBURGH PC CORNING

FOAMGLAS INSULATION

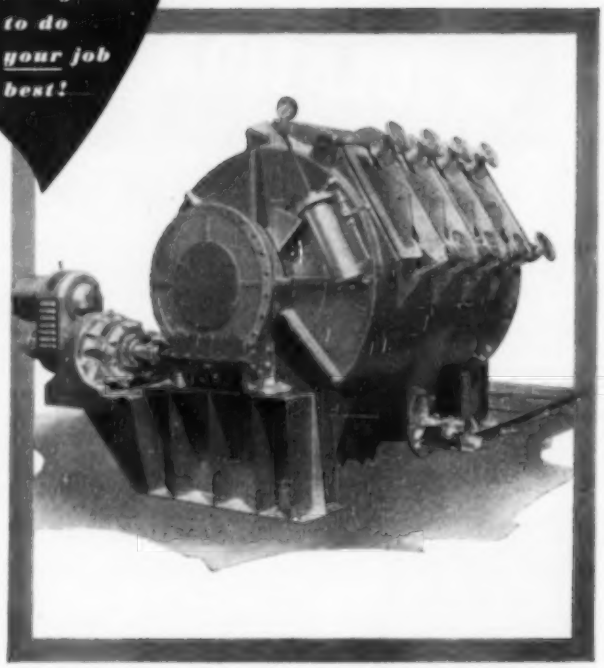
... when you insulate with FOAMGLAS... the insulation lasts!

See General American for

CREATIVE FILTER ENGINEERING

New Conkey Rotary Leaf Pressure Filter brings big advantages with "non-opening" operating cycle

Designed to do your job best!



Cyclic filtration of slow filtering slurries and clarification of suspensions

What are the big advantages of the new Conkey "non-opening" cycle operation? **Maximum labor saving obtained here! Only occasional valve manipulation needed. No worker-handling of filter cloths because the filter is not opened for cake discharge. Volatile solvents can be handled with negligible evaporation losses. Less danger to personnel from corrosive liquids. The entire filter may be insulated for operation at high or low temperatures. And the extremely compact design makes for minimum cubic footage and low installation charges.**

Rotation of leaves prevents settling. This helps build a non-tapering cake of uniform thickness and porosity for positive washing, maximum drying and clean discharge.

Other outstanding features: Filter medium may be either metal or fabric. Quick filter cloth changes are easily made by sector removal through inspection doors. Dry or sluicing cake discharge is provided for with complete cake discharge and cloth cleaning result.

To make some interesting comparisons, write for Technical Bulletin No. 105.

Other General American Equipment:
Turbo-Mixers, Evaporators, Thickeners, Dewaterers, Dryers, Towers, Tanks, Bins, Kilns, Pressure Vessels

OFFICES IN ALL PRINCIPAL CITIES

PROCESS EQUIPMENT DIVISION GENERAL AMERICAN TRADE MARK

Process Equipment Division
GENERAL AMERICAN
Transportation Corporation
Sales Office: 10 East 49th Street, New York 17, N. Y.
General Offices: 135 S. La Salle St., Chicago 90, Ill.

Combining a centrifugal with a mixing tank did away with trouble-making time lag

ANOTHER A.T.&M. SUCCESS STORY BY *Sam Spinner*









Let us bring you up to date on what modern centrifuging can do. JUST MAIL COUPON NO OBLIGATION

SAVE TIME, SPACE AND COSTS WITH

A.T. *and* M. CENTRIFUGING

AMERICAN TOOL & MACHINE COMPANY
1415 Hyde Park Ave., Boston 36, Mass.

Please send information on centrifuging applied to the following processes:
☐ Extraction ☐ Filtration ☐ Dehydration ☐ Coating ☐ Precipitation
☐ Sedimentation ☐ Impregnation

Write here any other process .....

Name ..... Title .....

Company .....

Street .....

City ..... Zone ..... State .....

HOW TO DROP $10,000.00

and not lose a cent

If you shipped riboflavin—a widely used vitamin—the very thought of somebody dropping one of your shipping drums would give you gray hairs. A single drum of riboflavin is worth upwards of $10,000. But one of Continental's regular line of shipping drums—the Leverpak drum—is the choice of many companies for safeguarding their most valuable products.

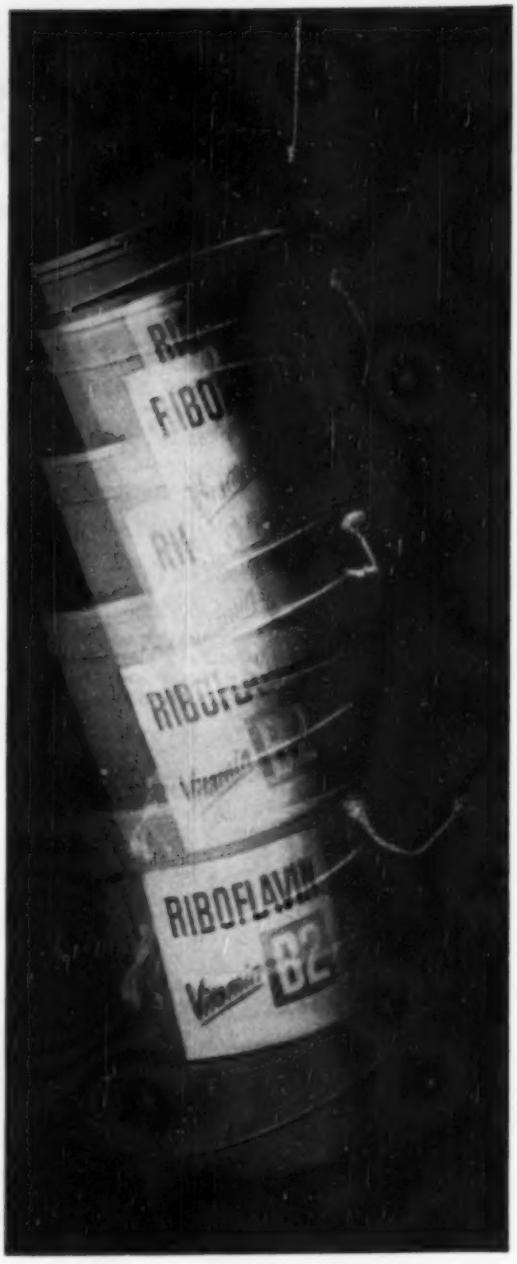
The stroboscopic photograph at the right shows a Leverpak drum containing four hundred pounds dropping four feet. It didn't leak, shatter or fracture. *Not a penny's worth of the contents will be lost!*

This Leverpak drum is just one example of Continental's ability to develop packages to meet exacting requirements. Like all Continental drums, it is light in weight to save shipping costs, and can be furnished in a wide variety of linings and coatings.

Whatever your product, Continental can supply you with a package that will stand up in service, stand out in appearance. Continental is famous for its fine lithography and decorative work. Drum, can, or paper container—if you have a packaging problem, our technical staff is ready to help you solve it. Continental is big enough and flexible enough to handle any packaging situation.



DRESS UP YOUR PRODUCT WITH A CONTINENTAL DRUM. Three types to choose from. The Leverpak drum, with its unique lever-locking device, for maximum protection under hard usage. 12- to 75-gallon sizes. . . . The Fiberpak drum—a rigid, light, all-fibre container in ¼- to 67-gallon sizes. . . . The Stapak drum with fibre body and metal top and bottom. Supplied in 2- to 32-gallon sizes.

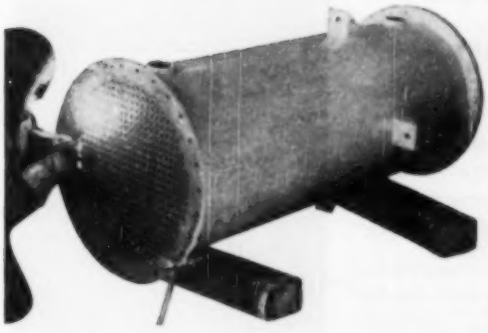


CONTINENTAL CAN COMPANY

FIBRE DRUM DIVISION • VAN WERT, OHIO

New York • Philadelphia • Pittsburgh • Tonawanda • Cleveland
Chicago • St. Louis • Los Angeles • San Francisco • Eau Claire

Fabricators Can Tell the Difference in *Carpenter* Stainless Tubing



All-Stainless condenser containing 481 Carpenter Stainless Tubes (¾" x 16 gauge, Type 304). The fabricator says: "We have used Carpenter Stainless Tubing for a number of years. In addition to the quality of the tubing, we like the good service we get from Carpenter's distributor."

Perfect seating on tube bundle jobs—easy bending and coiling—are advantages your fabricator can tell you about when he uses Carpenter *Heat Exchanger Quality* Stainless Tubing.

Because of the *wall uniformity* of this tubing, fabrication is not delayed by costly trial-and-error methods. Even on straight pipe line hook-ups, wall uniformity saves time in working with standard fittings and valves.

Analysis, Tolerance and Finish are guaranteed to be "as ordered" on every shipment of Carpenter Stainless Tubing.

HERE IS USEFUL INFORMATION ABOUT STAINLESS STEEL TUBING

This 12-page Carpenter Stainless Tubing folder will give you information on analyses, sizes, gauges, special shapes, etc. For your copy, just write a note on your company letterhead.



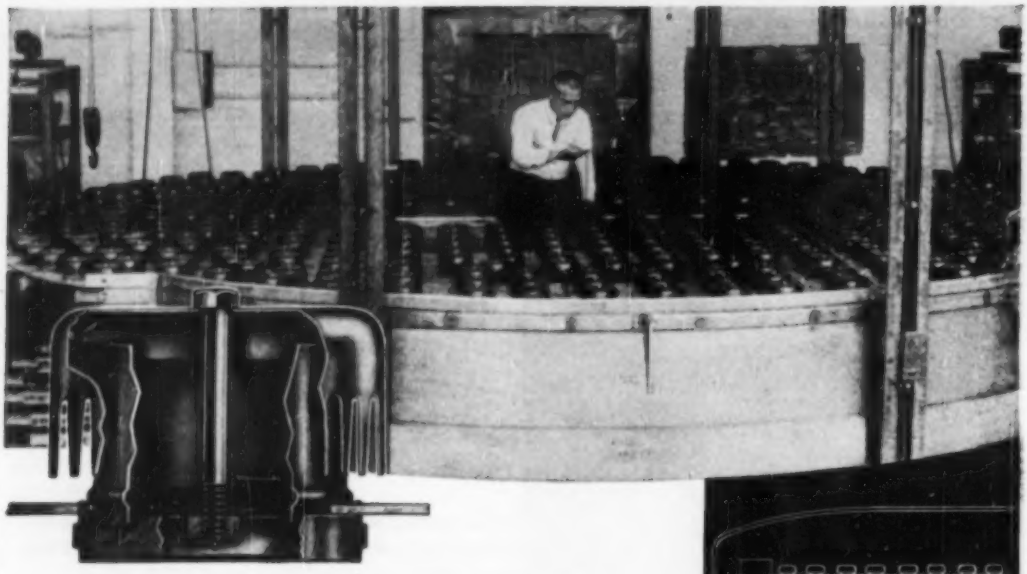
THE CARPENTER STEEL COMPANY
Alloy Tube Division, Union, N. J.
Export Department: Woolworth Bldg., New York 7, N. Y., "CARSTEELCO"

Carpenter
STAINLESS TUBING



—guaranteed on every shipment

ONE CALL DOES IT ALL
when you call your Carpenter Stainless Tubing Distributor. From printed information to technical service by mill men, your Carpenter Distributor can give you the information you need when you need it.



proven improvements in bubble tray design—



One truss for every two trays . . . with every alternate tray level free of major supports — this is the new bridge-type truss design that makes Gilbarco Duo-Level bubble trays faster to install, far easier to clean, and more rigid with lighter weight.

New cap assemblies are designed for quick, easy removal by one man working from the top side. There are no flanges or projecting edges around holes to slow up cleaning operations.

A new clamp design with improved packing protection minimizes joint leakage without causing distortion of the trays under temperature changes.

Duo-Level bubble trays, fabricated of alloy metals, are adaptable to refinery requirements either as new equipment or replacements. Gilbarco's large staff of engineers is at your service to demonstrate how Gilbarco bubble trays can be fabricated to meet the requirements of your process design.

Gilbarco

GILBERT & BARKER MFG. CO.

West Springfield, Mass. Toronto, Canada

Established in 1865

For Your TECHNICAL LIBRARY



Find out how you can get this equipment under the GE Maxi-service Plan. No cash outlay. Monthly service charge covers everything. Write for folder.

NO technical library is complete without this booklet: "Analytical Applications of X-Ray Diffraction Using Direct Measurement Technics." Send for *your* free copy now! Discover hundreds of proved applications of x-ray diffraction to metallurgy — to chemistry — to mineralogy and to the process industries.

And if knowing the submicroscopic structures of material you work with, and the ability to maintain the desired quality of materials throughout your manufacturing process are important . . . you'll want the XRD-3, General Electric X-Ray Corporation's diffraction equipment. The apparatus that enables you to analyze materials easily, quickly, directly — eliminate the guesswork and inference necessary with former methods of x-ray diffraction analysis.

Chemists, physicists, metallurgists, engineers have found it pays to standardize on General Electric XRD apparatus. Even for routine checks, they find it saves time, money and improves the quality of their product.

GENERAL ELECTRIC X-RAY CORPORATION

Mail today

General Electric X-Ray Corporation
Dept. WW-11, Milwaukee 14, Wisconsin

Please send me a complimentary copy of "Analytical Applications of X-Ray Diffraction Using Direct Measurement Technics."

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Company .....

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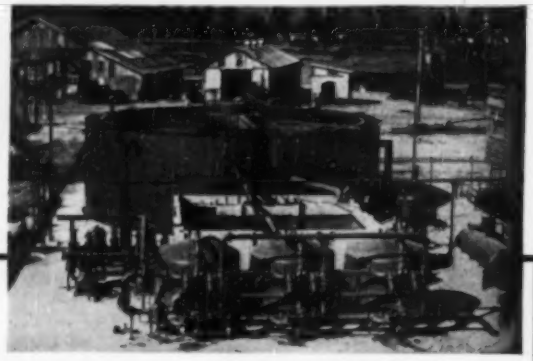
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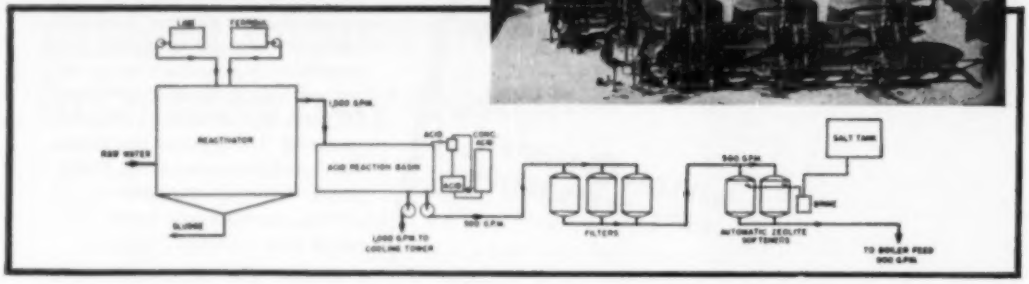
How Tide Water Oil Uses

GRAVER

FOR

COMPLETE WATER TREATMENT





At Tide Water Oil Company's Avon, California, refinery a turbid hard water supply is completely conditioned for boiler feed and cooling water services by Graver equipment consisting of Reactivator, Acid Feeding System, Anthrafilt Filters and Automatic Zeolite Softeners as shown in the flow chart above.

The raw surface water, with an inlet turbidity of 250 ppm, is first treated with lime and ferric sulfate in the Graver Reactivator. Here, partial reduction of hardness takes place while the turbidity is reduced to 3-5 ppm.

The Graver Acid Feeding System continuously and automatically proportions acid to the Reactivator effluent to reduce the alkalinity and to correct the pH to the desired value. Part of the water is thus conditioned for the cooling water system. The remainder of the water is filtered in the Graver Anthrafilt Filter and softened to zero hardness in the Graver Zeolite Softener for use as boiler feedwater.

The completeness of GRAVER service on this job is further accentuated by the facts that GRAVER:

1. **recommended to the Engineers the most effective type of equipment for their requirements.**
2. **built all the major component parts of each Water Treating Unit in its own shops.**
3. **furnished all needed accessories.**
4. **supervised the installation of the equipment.**

This *single responsibility* assures satisfactory operation of every GRAVER installation.

For best results in solving *your* water treatment problem, get the benefit of GRAVER'S 40 years of specialized experience, proven designs, and unequalled facilities. Be sure to ask for GRAVER recommendations.

GRAVER WATER CONDITIONING CO.

216 West 14th Street, New York 11, New York, U.S.A.

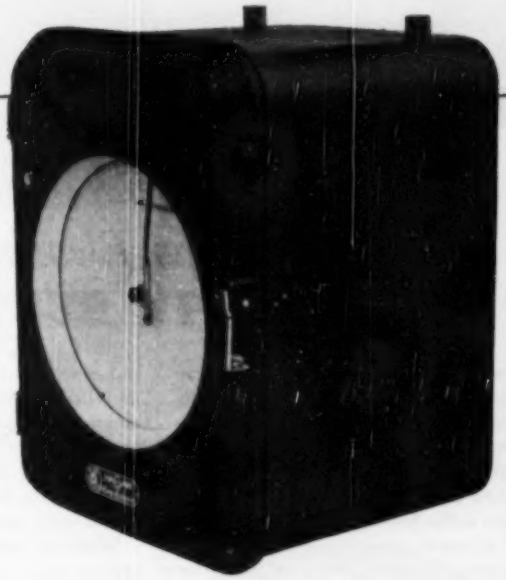
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GWC-415

GRAVER

A DIVISION OF GRAVER TANK & MFG. CO., INC. EAST CHICAGO, IND.

HIGH DIFFERENTIALS
ARE NO PROBLEM
with HAGAN
Ring Balance Meters



With ordinary meters, high differential pressures present serious difficulties—but not with the Hagan Ring Balance Meter.

Hagan meters for differentials up to 420 inches of water require exactly the same size case as low-differential meters. There is no drop leg, no U tube—everything is inside the case.

With both high-differential and low-differential Hagan Ring Balance Meters, checking and calibration are done by the same simple method, using a set of check weights which are furnished with the meter. The water column method, which is especially cumbersome when high differentials are involved, is unnecessary, and it offers no routine advantages over the check weight method.

For full information on Hagan Ring Balance Meters, fill in the coupon below or write to Hagan Corporation, Hagan Building, Pittsburgh 30, Pennsylvania.

HAGAN CORPORATION

RING BALANCE FLOW AND PRESSURE INSTRUMENTS
THRUSTORQ FORCE MEASURING DEVICES
BOILER COMBUSTION CONTROL SYSTEMS
METALLURGICAL FURNACE CONTROL SYSTEMS

Hagan Corporation
Hagan Building
Pittsburgh 30, Pennsylvania

Please send me further information on Hagan Ring Balance Meters. I am particularly interested in _____

NAME _____

POSITION _____

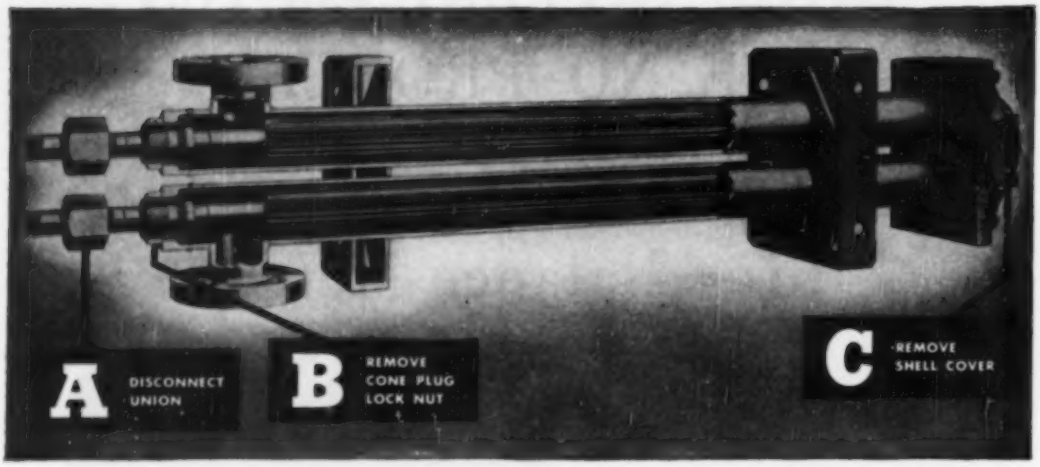
COMPANY _____

STREET AND NUMBER _____

CITY _____ ZONE _____ STATE _____

CE 11

as easy as A B C



Convenient Withdrawal of Heat Transfer Elements...one of many **TWIN G-FIN SECTION** *Advantages*

When you want to withdraw the heat transfer element of a G-R Twin G-Fin Section for inspection or cleaning, you need only remove 3 parts. No other heat exchanger has this advantage.

And this simplicity is typical of the Twin G-Fin Section. Its *design* is simple . . . it consists essentially of a pipe within a pipe . . . no tube sheets, no baffles, no internal joints to keep tight. Its *installation* is simple . . . these light-weight standard interchangeable units are readily handled; are easily stacked and connected in series or parallel for the desired capacity and temperature ranges. Its *maintenance* is simple . . . the operating records of more than 40,000 units, some of them in service for more than 15 years, have conclusively proven its durability and low upkeep cost.

Whatever may be your heat transfer requirements, investigate this universal heat exchanger . . . used on a greater variety of condensing, cooling and heat exchanger services than any other design of apparatus.



Write for Bulletin 1614, describing the many advantages and applications of the G-R Twin G-Fin Section.

GR—101

THE GRISCOM-RUSSELL CO., 285 MADISON AVENUE, NEW YORK 17, N. Y.

GRISCOM-RUSSELL

Pioneers in Heat Transfer Apparatus



PROBLEM...
Industrial Waste Pollution Abatement

SOLUTION...
CYCLATOR®
for Chemical Treatment

The Acme Paper Board Division of the Federal Paper Board Co., Reading, Pa., had the problem of treating its mill wastes before discharging them to a nearby creek.

A CYCLATOR and Cascade Aerator were installed to treat white water that varied daily in chemical characteristics. Suspended solids are reduced 96% from an average of 419 ppm in the raw waste. The underflow, averaging 3.3% by weight, is recovered and returned to process.

This is but another chapter in a growing success story for Infilco chemical waste treatment equipment.

Infilco has equipment to handle practically all waste disposal problems:

FOR CHEMICAL TREATMENT

The *CYCLATOR* for the treatment of wastes containing large amounts of light suspended solids or which upon treatment produce voluminous sludges.

The *ACCELATOR* for the treatment of wastes which lend themselves to clarification by chemical treatment or coagulation and which produce relatively small sludge volumes.

Unexcelled performance of working installation plus the "know-how" gained through over 50 years experience in the field of water and waste treatment are your assurance that your waste treatment problem will be given an unbiased appraisal by a staff of experienced men who stand ready to assist you and your engineers in finding the best solution to your problem.

Consult your Telephone Redbook. Call in our nearest Field Engineer, or write us for Bulletin 70-A. There is no obligation.

Partial List of Recent INFILCO Industrial Waste Treatment Plants

CYCLATORS®

Carolina Paper Board Co.	Charlotte, N. C.
Continental Diamond Fibre Co.	Bridgeport, Pa.
Federal Paper Board Co.	Reading, Pa.
W. C. Hamilton & Sons Co.	Miquon, Pa.
New Departure Division General Motors Corporation	Sandusky, Ohio
New York & Pennsylvania Co.	Johnsonburg, Pa.
River Raisin Paper Co.	Monroe, Mich.
Taylor Fibre Co.	Betzwood, Pa.
American Deflbrator Co.	Mexico City, Mex.

ACCELATORS®

Electric Autolite Co.	Lockland, Ohio
Procter & Gamble	Dallas, Texas
Magnolia Petroleum Co.	Pennant, Texas
Clark Equipment Co.	Jackson, Mich.
Rock Island Refining Co.	Zionsville, Ind.
Public Service Electric & Gas Co.	Jersey City, N. J.
General American Transportation Co.	East Chicago, Ind.
Rapid City Air Base	Weaver, S. D.

INFILCO
* BETTER WATER CONDITIONING AND WASTE TREATMENT SINCE 1894 *

INFILCO INC.
NEW YORK 17 • TUCSON • CHICAGO 16
SALES OFFICES IN TWENTY SIX PRINCIPAL CITIES

WORLD'S LEADING MANUFACTURERS OF WATER CONDITIONING AND WASTE TREATING EQUIPMENT



—of a Kidde Dry Chemical Fire Extinguisher

Pound for pound, *Kidde* Dry Chemical Fire Extinguishers give you more *protection* for fires in flammable liquids, live electrical equipment and for textiles.

Proof? Factory Mutual Laboratories requires a 20 lb. dry chemical fire extinguisher, in the hands of an experienced operator, to effectively cover 25 square feet of burning area. *The Kidde 20 pounder covered 35 square feet . . . a 44% margin of safety!* And—the tests require a 30 pounder to cover 35 square feet . . . *but Kidde's Dry Chemical extinguisher reached out 48 square feet!*

Why is Kidde better? A special Diffuser Horn applies heat-absorbing, fire-smothering dry chemical in an effective cloudlike pattern that blankets the danger area, helps eliminate splashing of burning liquids, and protects the operator from heat.

Ruggedly built, simply constructed, quick to recharge and equipped with easy-to-operate Trigger Finger Control, *Kidde* Dry Chemical Extinguishers mean sure death to fire—and extra safety for you.



Kidde Dry Chemical Extinguishers can be used in normal standing position, just pick unit up, point the horn, pull the trigger.



Streamlined diffuser horn gives better discharge pattern, means greater coverage, insulating blanket for the operator.

Kidde

Walter Kidde & Company, Inc., 1128 Main Street, Belleville 9, N. J.
In Canada: Walter Kidde & Company, Ltd., Montreal, P. Q.



"approximate savings of $3,000 per year in repair costs and labor"

That's Fred A. Garcia, pictured with an installation of LaBour pumps in the Luke, Maryland plant of West Virginia Pulp and Paper Company, where he is superintendent of the electrolytic department. Here's what he says:

"The LaBour pumps have been operating in our caustic system for the past 20 months, with an approximate saving of $3,000 per year in repair parts and labor as compared with pumps in the initial installation *** handling caustic cell liquor at 150° F. *** recycled until it reaches a concentration of 50% NaOH, with temperatures up to 212° F. *** 18 hours per day, 7 days per week *** thank you for valuable help in elimination of our pumping troubles and cutting our maintenance cost to a minimum."

We'll be glad to supply details about the application of LaBour pumps to your problem. Consult us without cost or obligation.

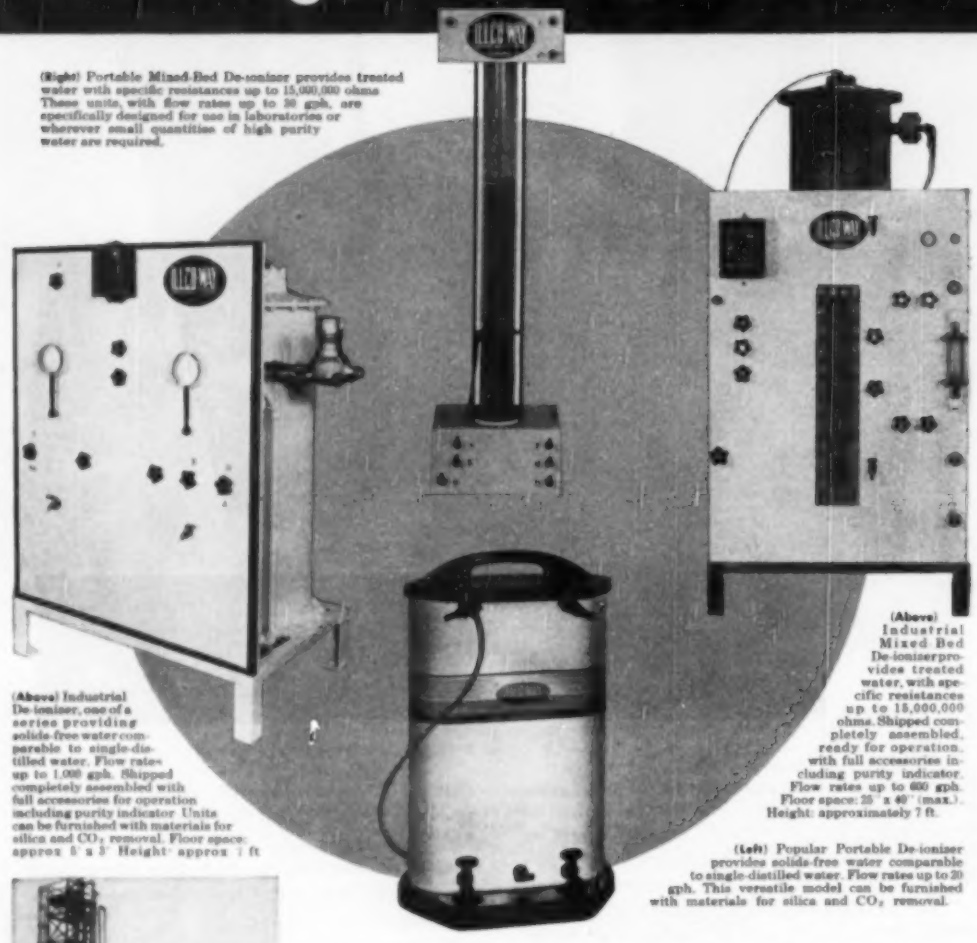
ORIGINAL MANUFACTURERS OF THE SELF-PRIMING CENTRIFUGAL PUMP

LABOUR

THE LABOUR COMPANY, INC. ★ Elkhart, Indiana, U.S.A.

The *Complete* Line of "Packaged" DE-IONIZERS

(Right) Portable Mixed-Bed De-ioniser provides treated water with specific resistances up to 15,000,000 ohms. These units, with flow rates up to 30 gph, are specifically designed for use in laboratories or wherever small quantities of high purity water are required.



(Above) Industrial De-ioniser, one of a series providing solids-free water comparable to single-distilled water. Flow rates up to 1,000 gph. Shipped completely assembled with full accessories for operation including purity indicator. Units can be furnished with materials for silica and CO_2 removal. Floor space: approx. 5' x 3'. Height: approx. 7 ft.

(Above) Industrial Mixed Bed De-ioniser provides treated water, with specific resistances up to 15,000,000 ohms. Shipped completely assembled, ready for operation, with full accessories including purity indicator. Flow rates up to 600 gph. Floor space: 25" x 40" (max.). Height: approximately 7 ft.

(Left) Popular Portable De-ioniser provides solids-free water comparable to single-distilled water. Flow rates up to 20 gph. This versatile model can be furnished with materials for silica and CO_2 removal.



Requirements for pure water in many plants are served by these famous "packaged" units . . . quickly available, quickly installed. For greater flow requirements, ILLCO-WAY industrial installations are engineered to provide any flow, any volume on a given water supply. A typical 300 gpm installation is shown at left. Write today for detailed information.

ILLINOIS WATER TREATMENT CO., 844-11 Cedar St., Rockford, Illinois • 7310-B11 Empire State Bldg., New York City

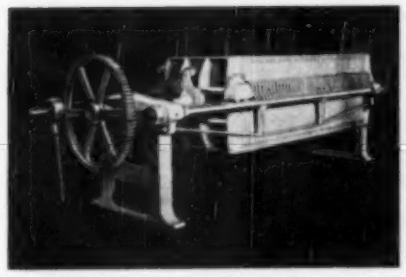
ILLCO-WAY

DE-IONIZING
DE-ALKALIZING
SOFTENING

Simplicity of design, economy of operation, flexibility of application

SPERRY FILTER PRESSES

These three advantages...simplicity, economy, flexibility...are the reasons for the virtually universal acceptance of the plate filter press as engineered for your process operation by Sperry. Here is what these advantages mean.



Simplicity of design results in a minimum investment in processing equipment and a minimum cost for installation. And, once installed, operation is trouble-free.

Simplicity of design results, too, in economy of operation with no skilled or technical personnel required to obtain first quality results. The simplest types of filter cloth and paper may be used just as they are cut from the roll. The filtrate is of maximum clarity, the cake is delivered thoroughly washed and in slab form ready for the drier trays.

Regardless of filter mixture, Sperry presses have the flexibility required to handle it successfully. Pressures and temperatures pose no problem; nor does resistance to acids or alkalies. The liquid need not be exposed to the atmosphere and the filtrate may be delivered to a point higher than the filter. All types of filter bases may be used and varied at minimum cost should your processing plans be revised.

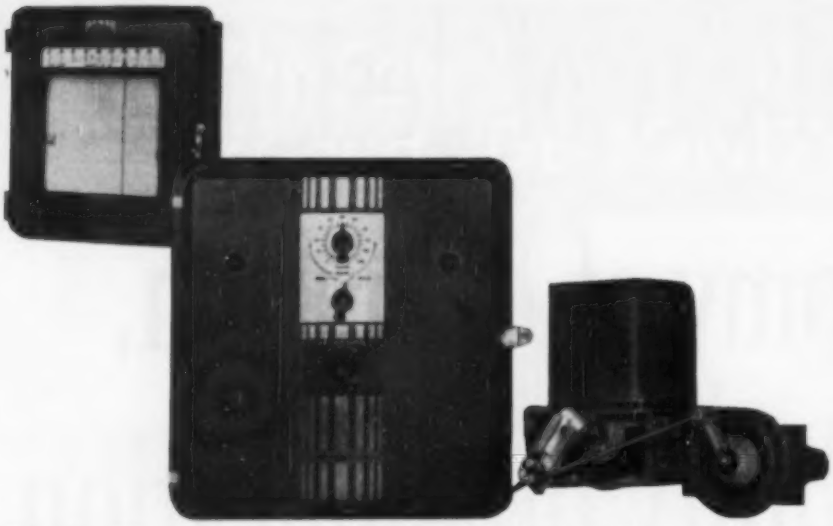
Whatever your filtration problem, you will find the answer in simplicity, economy and flexibility ... the advantages offered by the Sperry plate filter press. Why not put Sperry's fifty years experience to work on this problem now? There is no obligation.

D. R. SPERRY & COMPANY
BATAVIA, ILLINOIS
Filtration Engineers for Over 50 Years

Eastern Sales Representative:
H. E. Jacoby, M. E., 205 E. 42nd St.,
New York 17, N. Y.,
Phone: Murray Hill 4-3581

SPERRY FILTER PRESSES

Western Sales Representative:
R. M. Pilhashy,
833 Merchants Exchange Bldg.
San Francisco 4, Calif.
Phone: DO 2-0375



P.A.T. '50 is pyrometric control for increasing industrial production

With production demands reaching toward all-time highs, this new P.A.T.' 50 Control comes at the ideal time to help thousands of firms increase industrial process output. Here's why:

This control has something that's brand new. It acts on the *speed* of swings in temperature as well as on their size and permanence. Thus, if temperature changes gently, it is gently nudged back into line. But if it starts off briskly, P.A.T. '50 reacts briskly. The faster the change, the further P.A.T. '50 moves the fuel valve. Then, at the instant this action begins to head off the change, the Control starts backing away. By putting on the brakes it brings temperature back into line smoothly, rapidly.

This *speed response* is "Rate Action", and P.A.T. '50 is the only electric positioning control which makes it available. It's one of L&N's unique contributions to automatic regulation.

Also, the familiar Proportioning & Reset Actions are even more responsive than before. They stop the normal, everyday temperature changes which are started by changes in the size or permanence of the heat load. These P.A.T. '50 actions now have more range of adjustment and sensitivity than ever before.

The resulting improvement in control shows up at all times, but especially when temperature is edging away from the control point, or leveling off incorrectly. P.A.T. '50 gives results far superior to any previous electric control.

The News Is In The Control Unit. Everything new in P.A.T. '50 is in the Control Unit (center picture) . . . which connects a Speedomax or Micromax Recording Controller to a fuel valve drive. Earlier P.A.T. Controls can be converted to P.A.T. '50 by replacing the unit and making slight changes in the controller. The new unit has no moving parts except two hermetically sealed relays.

For complete details, contact our nearest office, or write us at 4916 Stenton Ave., Philadelphia 44, Penna.



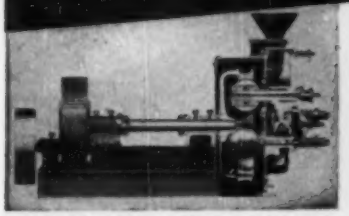
Shown here are just a few of the information sheets on P.A.T.'50 Control. The whole set is yours for the asking.

MEASURING INSTRUMENTS · TELEMETERS · AUTOMATIC CONTROLS · HEAT-TREATING FURNACES

LEEDS & NORTHRUP CO.

Ind Ad ND4-33(2)

Step-up Production Lower Preparation Costs with STURTEVANT EQUIPMENT



RING ROLL MILL — for medium and fine reduction of hard or soft materials (10 to 200 mesh). Open-door accessibility for easy cleaning. Available in many sizes and capacities.



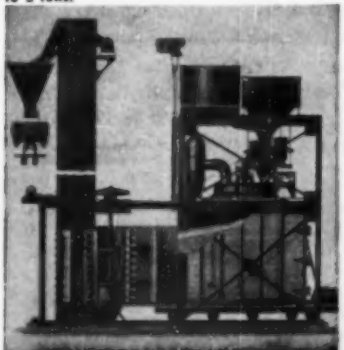
TAILINGS ROTARY PULVERIZER — increases output of fertilizer tailings . . . will not clog . . . leaves no daily accumulation of unground pellets. Capacities up to 25 tons per hour.



DRY BATCH MIXERS — 4-way mixing action mixes two or more ingredients into an inseparable, homogeneous mass. Open door accessibility makes cleaning easy. Capacities ½ ton to 2 tons.



MOTO-VIBRO SCREENS — screen everything screenable. Open and closed models with or without feeders. Many types and sizes . . . screens from ½" to 60 mesh.



DEN AND EXCAVATOR — speeds processing of superphosphates. Easily operated by two men . . . produces 16 to 40 tons per batch and up to 480 tons per day of superior fertilizer free from lumps.



AIR SEPARATOR — for finest separation of materials. Capacities from ¼ ton to 50 tons per hour in fineness of 40 to 325 mesh and finer. Increases production of fines, cuts power consumption costs.

Sturtevant Processing Equipment . . . Grinders, mixers, separators, screens, etc. . . . can help you *reduce* today's high manufacturing costs by increasing both machine and operator output, lowering production costs, assuring high quality products.

Records in all types of industries — chemical, plastics, ceramics, cement, food, construction — prove that this equipment works dependably day in, day out with little, if any, maintenance.

Used individually or linked together in proper sequence, they do the job faster and easier than other types . . . handle a larger variety of work.

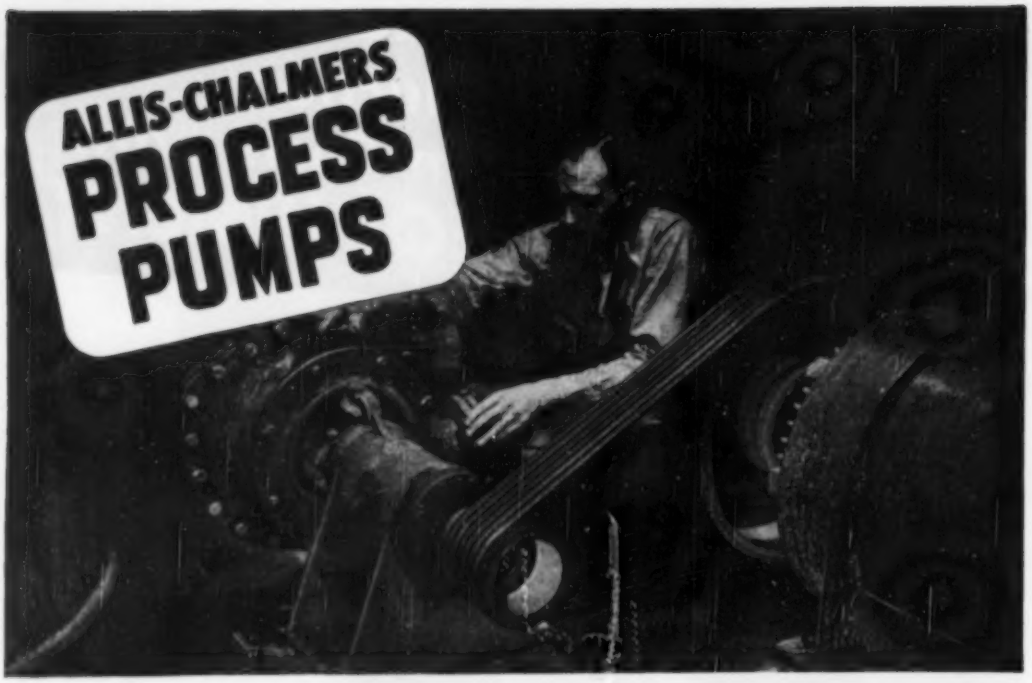
It will pay you to investigate Sturtevant Processing Equipment for your plant. There is a size and type of machine that will meet your requirements. Write for information.

STURTEVANT MILL COMPANY

200 CLAYTON STREET
BOSTON 22, MASSACHUSETTS

Designers and Manufacturers of:

CRUSHERS • GRINDERS • SEPARATORS
CONVEYORS • MECHANICAL DENS
and EXCAVATORS • ELEVATORS
MIXERS



CUT PUMP GRIEF

ON ABRASIVE AND CORROSIVE JOBS

THIS ALLIS-CHALMERS PROCESS PUMP gives you many times the wear of an ordinary pump, even those made of special materials. One user had been replacing major parts in his old pump every six to ten weeks. An A-C process pump ran twenty months on the same job without repair. Here is why these savings are common:

UNIQUE DESIGN

Packing is on suction side. Pressure on packing is limited to suction conditions. This prevents excessive packing and shaft sleeve wear and leakage. Double volute casing balances hydraulic forces on rotating parts. Cuts vibration and eliminates pounding on operations where conditions vary, such as in pumping from filters.

Adjustment of wear between impeller and impeller wear plate may be made without dismantling pump. Parts subject to unequal wear are separated for easy, low-cost replacement.

4 MATERIALS IN STOCK

All parts are stocked in Aluminum Bronze, Ni-resist, 316 Stainless Steel and 18% Chrome Steel. You don't need to carry a spare parts stock. Only Allis-Chalmers can supply pump, motor, *Texrope* V-belt drive and motor control — all from one stock without waiting.

Ask your A-C Authorized Dealer or Sales Office representative to give you facts and figures on what A-C process pumps can do for you. Or write for Bulletin 08B6615.

A-2989

ALLIS-CHALMERS, 1147A SO. 70 ST
MILWAUKEE, WIS.

Texrope and *Vari-Pitch* are Allis-Chalmers trademarks.

Sold . . .
Applied . . .
Serviced . . .

by Allis-Chalmers Authorized Dealers, Certified Service Shops and Sales Offices throughout the country.



MOTORS — ½ to 25,000 hp and up. All types.



CONTROL — Manual, magnetic and combination starters; push button stations and components for complete control systems.



TEXROPE — Belts in all sizes and sections, standard and Vari-Pitch sheaves, speed changers.

ALLIS-CHALMERS

Multi-storage availability with ESSO SOLVENTS!



With water terminal and storage facilities in industrial centers, ESSO SOLVENTS are always conveniently *available*. Prompt shipment and quick delivery to your door is assured in any quantity . . . tank cars, tank trucks, or drums. Specify Esso Solvents for dependable delivery *when* you need them, *where* you need them.

YOU CAN DEPEND ON ESSO SOLVENTS FOR

- **MULTI-STORAGE AVAILABILITY** — water terminals in industrial centers.
- **MODERN HANDLING METHODS** — separate tank storage, pumping lines, tank cars and trucks, are used in all Esso Solvent handling operations. Prompt, efficient delivery to your door is assured.
- **UNIFORMITY** — made in modern refineries from carefully selected crude oil sources.
- **ECONOMY** — closely-controlled quality gives constant, efficient industrial processing, high-quality products.
- **CONTROLLED EVAPORATION** — available in a wide range of evaporation rates with precise characteristics to meet your requirements.
- **SOLVENCY** — Esso aliphatics and Solvesso aromatics cover both high and low solvency ranges.

Controlled high quality helps produce larger profits with versatile, dependable Esso Solvents.

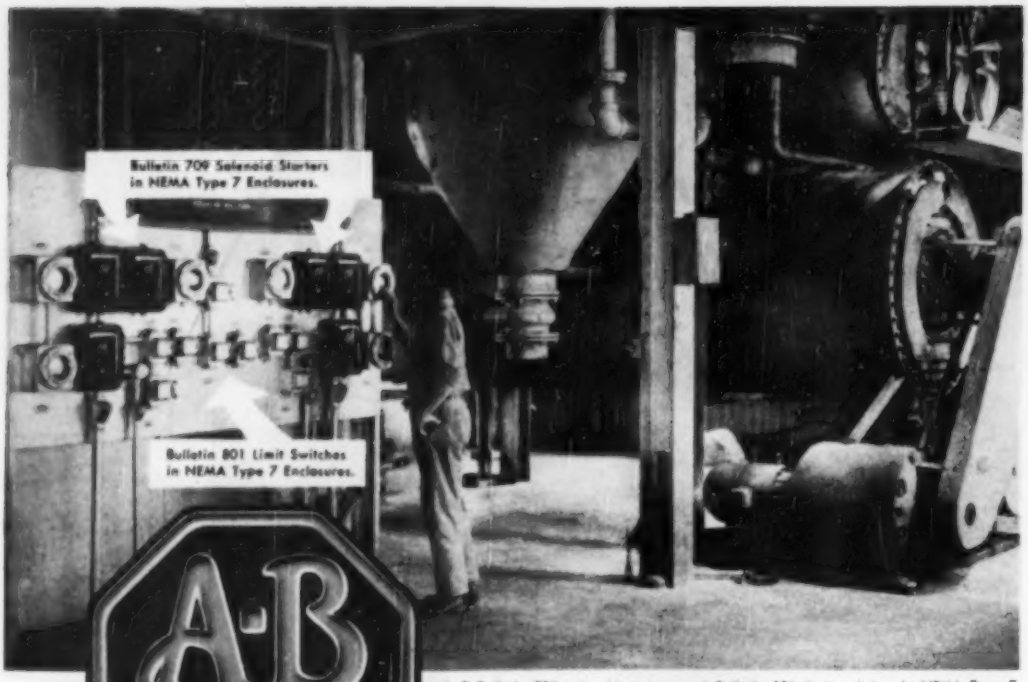
Esso PETROLEUM SOLVENTS

SOLD IN Me., N. H., Vt., Mass., R. I., Conn., N. Y., N. J., Pa., Del., Md., D. C., Va., W. Va., N. C., S. C., Tenn., Ark., La.

ESSO STANDARD OIL COMPANY — Boston, Mass. — New York, N. Y. — Elizabeth, N. J. — Philadelphia, Pa. — Baltimore, Md. — Richmond, Va. — Charleston, West Va. — Charlotte, N. C. — Columbia, S. C. — Memphis, Tenn. — Little Rock, Ark. — New Orleans, La.

FOR TECHNICAL ASSISTANCE

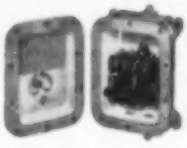
If you have a solvents problem or want further information on the specifications and characteristics of Esso Solvents—write or call our office nearest you. Our technicians will be glad to assist you.



A-B Bulletin 709 solenoid starters and Bulletin 801 limit switches in NEMA Type 7 enclosures in mill of the Central Soya Co., Fort Wayne, Indiana.

SAFE STARTERS for EXPLOSIVE ATMOSPHERES

Protect Men and Equipment with NEMA Type 7 Enclosures



Bulletin 709 solenoid starter in a NEMA Type 7 enclosure.



Bulletin 609 manual starter—NEMA Type 7 enclosure.



One type of A-B Bulletin 801 limit switch in a NEMA Type 7 enclosure.

Where hazardous gases or vapors exist, install Allen-Bradley motor controls in NEMA Type 7 enclosures. Constructed of cast iron with wide machined flanges, these bolted enclosures provide maximum protection.

These starters are also available in enclosures for wet locations, hazardous dust, and corrosive atmospheres.

Allen-Bradley solenoid starters are ideal for bolted enclosures, because their double break, silver alloy contacts need no maintenance. Only ONE moving part—no pins, pivots, bearings, or jumpers to cause trouble.

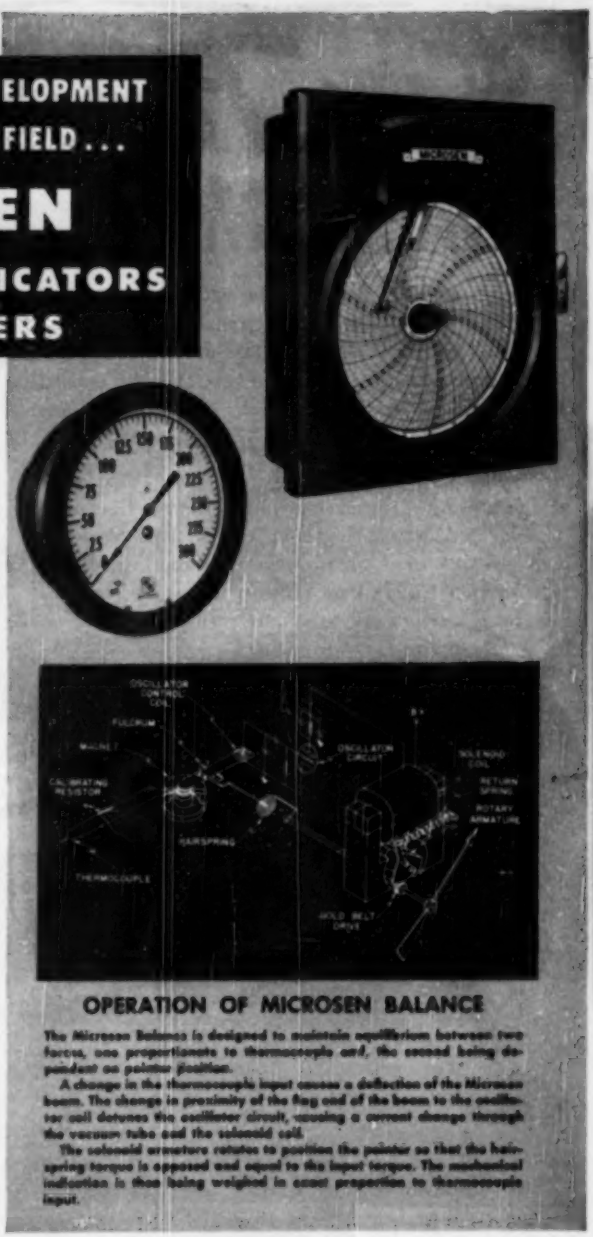
Allen-Bradley Co.
1337 S. First St. Milwaukee 4, Wis.

ALLEN-BRADLEY
SOLENOID MOTOR CONTROL
QUALITY

A NEW AND UNIQUE DEVELOPMENT IN THE PYROMETER FIELD...

MICROSEN

TEMPERATURE INDICATORS AND RECORDERS



Thermocouple actuated, Microsen Temperature Indicators and Recorders were designed to fill the need for a rugged, yet economical, type of electrical instrument capable of measuring temperature between minus 100° and plus 3000° F.

Power actuation and construction simplicity of these instruments supplant the delicate and fragile construction of millivolt pyrometers and eliminate the need for slidewires, standard cells, delicate moving contacts, or complicated mechanisms found in the more costly types of potentiometers.

Sensitive to low power input, the Microsen Balance assures precise performance in the measurement of temperature. Its characteristic rotary motion adapts it, particularly, to circular dial indication with consequent reduction of tendency to parallax error. A high torque rotary solenoid positions the pointer with "pin point" accuracy and allows the use of large indicating dials.

The Microsen Balance is enclosed in a sealed housing protecting all measuring elements from dust and corrosive vapors.

Thermocouple cold junction compensation is accomplished by a small, built-in, and heated chamber maintained at a constant temperature regardless of ambient temperature effects.

For complete details, write for Bulletin 404.

OPERATION OF MICROSEN BALANCE

The Microsen Balance is designed to maintain equilibrium between two forces, one proportionate to thermocouple emf, the second being dependent on pointer position.

A change in the thermocouple input causes a deflection of the Microsen beam. The change in proximity of the flag end of the beam to the oscillator coil detunes the oscillator circuit, causing a current change through the vacuum tube and the solenoid coil.

The solenoid armature rotates to position the pointer so that the hairspring torque is opposed and equal to the input torque. The mechanical indication is thus being weighed in exact proportion to thermocouple input.

MICROSEN ELECTRICAL INSTRUMENTS

A Product of

MANNING, MAXWELL & MOORE, INC.

STRATFORD • CONNECTICUT

Makers of 'Microsen' Electrical and 'American' Industrial Instruments, 'Hancock' Valves, 'Ashcroft' Gauges, 'Consolidated' Safety and Relief Valves. Builders of 'Shaw-Box' Cranes, 'Budgit' and 'Load Lifter' Hoists and other lifting specialties.

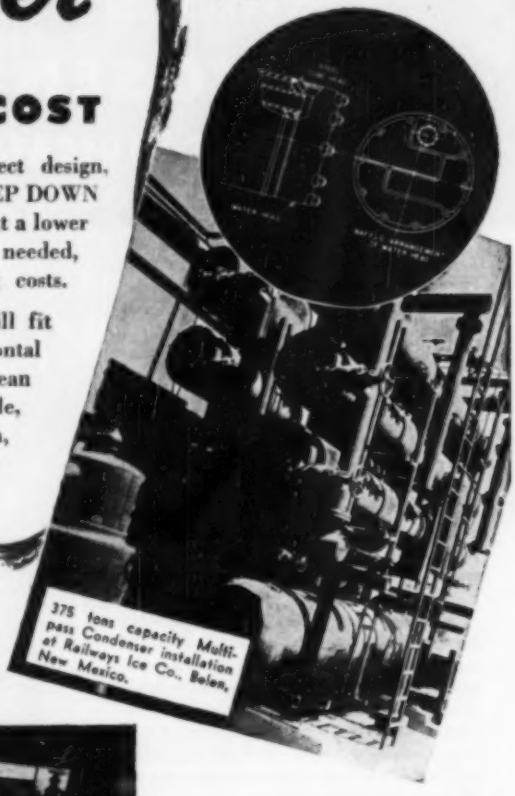
$ave Power and REFRIGERATION COST

Vogt Condensers, because of their correct design, STEP UP the rate of heat transfer and STEP DOWN head pressures. With the liquid delivered at a lower temperature, smaller compressor capacity is needed, saving in original as well as operating costs.

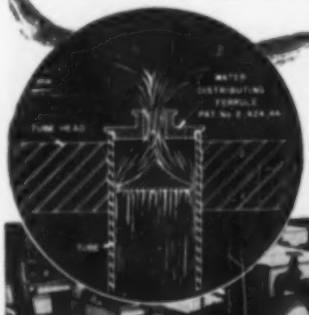
One of the two basic types illustrated will fit your operations exactly. Install Horizontal Multipass (closed type) for use with clean waters. Where the water is hard, forms scale, contains mud or promotes fungus growth, Vertical Single Pass (film type) which can be cleaned in operation, are recommended.

Horizontal Multipass Condensers
(Closed Type)

Water circulated in tubes traverses the length of the unit a number of times as determined by baffles in the heads.

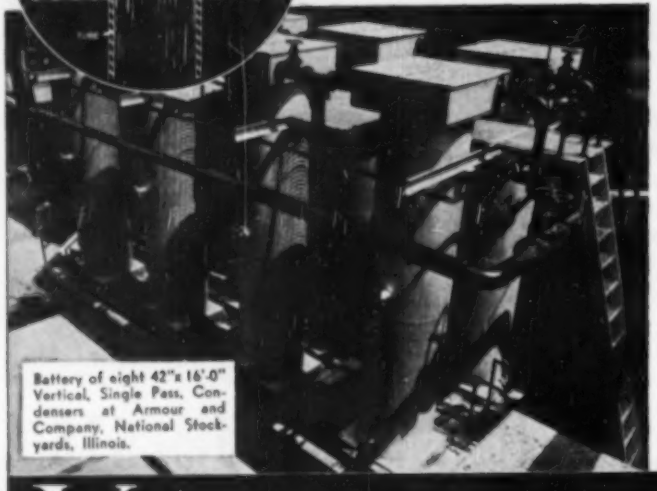


375 tons capacity Multipass Condenser installation at Railways Ice Co., Belen, New Mexico.



Vertical Single Pass Condensers
(Film Type)

Patented ferrules give equal distribution of water to and over the surfaces of all tubes in a unit.



Battery of eight 42"x 16'-0" Vertical, Single Pass, Condensers at Armour and Company, National Stockyards, Illinois.

HORIZONTAL and VERTICAL TYPES SHELL and TUBE CONDENSERS For Every Service

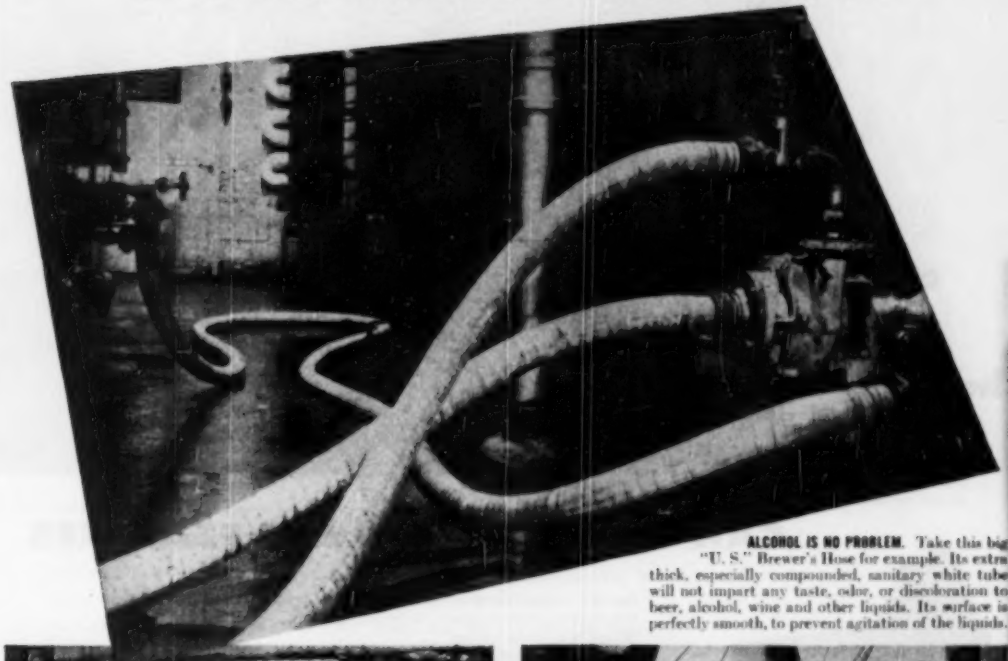
Write For Bulletin RC-1

HENRY VOGT MACHINE COMPANY
INCORPORATED
1000 W. ORMSBY ST., LOUISVILLE 10, KY., U.S.A.
Branch Offices: NEW YORK, CHICAGO, CLEVELAND, DALLAS, PHILADELPHIA, ST. LOUIS, CHARLESTON, W. VA.

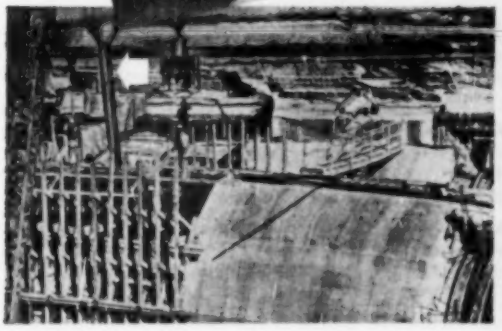
Vogt REFRIGERATION CONDENSERS

TODAY'S HOSE CAN SWALLOW ANYTHING!

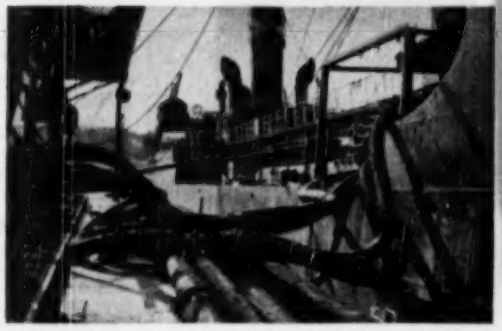
U. S. RUBBER'S LINE OF FLEXIBLE CARRIERS INCLUDES PRODUCTS THAT CAN HANDLE PRACTICALLY ANY DESTRUCTIVE LIQUID KNOWN



ALCOHOL IS NO PROBLEM. Take this big "U. S." Brewer's Hose for example. Its extra thick, especially compounded, sanitary white tube will not impart any taste, odor, or discoloration to beer, alcohol, wine and other liquids. Its surface is perfectly smooth, to prevent agitation of the liquids.



ON THIS BIG DAM in the Middle West contractors used U. S. Elephant Trunk Hose for dropping concrete speedily and efficiently into tight forms and inaccessible places. Since the hose is flexible, it can be maneuvered and led into spots where concrete could not be dropped directly.



RESISTANCE TO PETROLEUM OILS is built into U. S. Oil Hose for suction or discharge work at refineries, terminals, and loading or unloading tankers or barges. The special U. S. constructions combine adequate pressure resistance and durability while allowing required flexibility.

United States Rubber Company makes hose that resists powerful acids, paint and chemicals of many kinds. No matter what your hose problem may be, you can be sure that "U. S." technicians either already have the right answer, or will obtain it for you. Write:

A PRODUCT OF

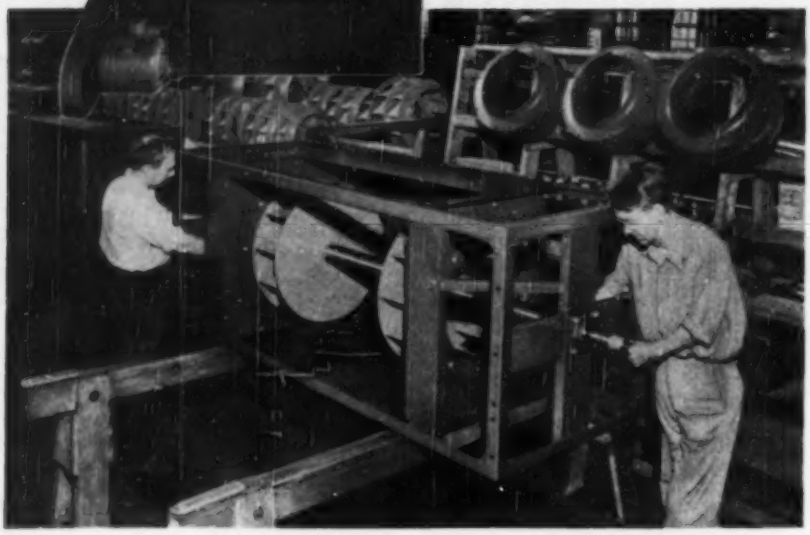
U.S.RUBBER
SERVING THROUGH SCIENCE

UNITED STATES RUBBER COMPANY

MECHANICAL GOODS DIVISION • ROCKEFELLER CENTER, NEW YORK 20, N. Y.

AH Unit

AH fan section being assembled



no other air handling unit

CAN MATCH ALL THESE FEATURES



AV Unit

Superior, rugged construction and sound engineering have brought wide acceptance to Westinghouse Air Handling Units.
What's behind this record . . .

1. CONSTRUCTION—Sectionalized casings have welded, gusseted structural angle frames, half-inch rigid internal insulation. Rotating parts are heavy and rugged. Result—Non-distortion in shipping, easier assembly, smooth operation, better appearance, lower maintenance costs.

2. FLEXIBILITY—Westinghouse sectionally designed components—fans, heating and cooling coils, filters, mixing boxes, bases and drains—can be assembled for any air handling operation. Result—Installations "tailor-made" to your particular job requirements.

3. PERFORMANCE—Westinghouse Silentvane fan wheels are known for their stable non-pulsating air flow, silent operation, and non-overloading horsepower characteristics.
Result—Long, trouble-free service life.

Behind these important features is the UNDIVIDED RESPONSIBILITY of Westinghouse for *every* major part. No other manufacturer today offers this "plus" value. For complete information on how Westinghouse Air Handling Units—either Type AH (Horizontal) or Type AV (Vertical)—will meet your needs, contact your local Sturtevant office, or write to Westinghouse Electric Corporation, Sturtevant Division, Hyde Park, Boston 36, Massachusetts.

YOU CAN BE SURE...IF IT'S

Westinghouse

J-80191B



Actual installation of a bank of 50 ozone generators — capable of generating 3,000 lbs. of Ozone per day. Shown with simple control panels.

Here is the perfect answer to your problem of finding a commercial oxidant for your industrial uses.

Welsbach Ozonators give you a trouble-free, easy, economical way to produce Ozone . . . the ideal oxidant . . . in quantities to fill your commercial and industrial needs. You'll marvel at the way these dependable, efficient, large capacity Welsbach Ozonators can be quickly integrated into your processes.

Welsbach Ozonators of standard size may be combined easily into a single compact housing with complete panel control, to meet your every anticipated ozone requirement.

Laboratory type ozonators are available for your preliminary investigation. With no obligation on your part, Welsbach Ozone engineers will furnish you with information on your ozonator installation needs. Write today for the "Welsbach Information Sheet for Industrial Uses." Just fill it out and mail it in. A preliminary report will be returned to you promptly.

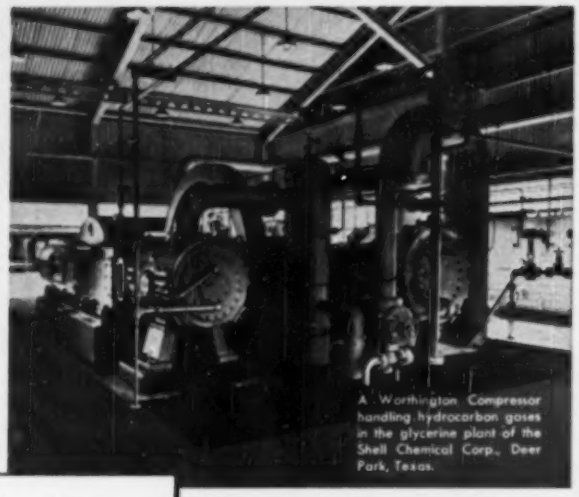
Check these advantages:

- An ideal oxidant
- Low cost
- Easy installation
- Simple operation
- Low maintenance cost
- Uniform results
- Consulting service without obligation available

THE WELSBACH CORPORATION

OZONE PROCESSES DIVISION

1500 Walnut Street **Philadelphia 2, Pa.**



A Worthington Compressor handling hydrocarbon gases in the glycerine plant of the Shell Chemical Corp., Deer Park, Texas.

ONLY THE *Right* COMPRESSOR CAN CUT YOUR GAS-HANDLING COSTS

The preference for Worthington Compressors throughout the chemical industries is based not only on proved performance, but on getting the correct answers to questions like these:

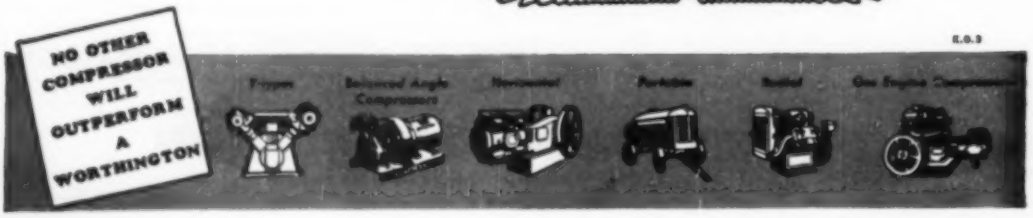
How does the chemical composition of gas affect its behavior during compression? What is the preferred design of equipment for the specific gas to be handled? How can performance be improved when corrosive gas is being compressed?

Whatever your own compressor applications may be, there's a great deal of information you need to know. Worthington can give it to you. To users everywhere, this — backed by more than 50 years' experience in building and designing compressors for every purpose — has proved a worthwhile aid to more efficient, lower cost processing.

GET THE FACTS

Keeping pace with the chemical field's constant rapid progress, Worthington builds compressors to handle the widest range of gases. Let us give you the facts on how their top performance combines with low operating and maintenance costs to prove *there's more worth in Worthington.* Write, describing your requirements, to *Worthington Pump and Machinery Corporation, Compressor Division, Buffalo, N. Y.*

WORTHINGTON

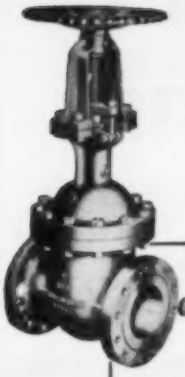


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Sectional view of Series 300

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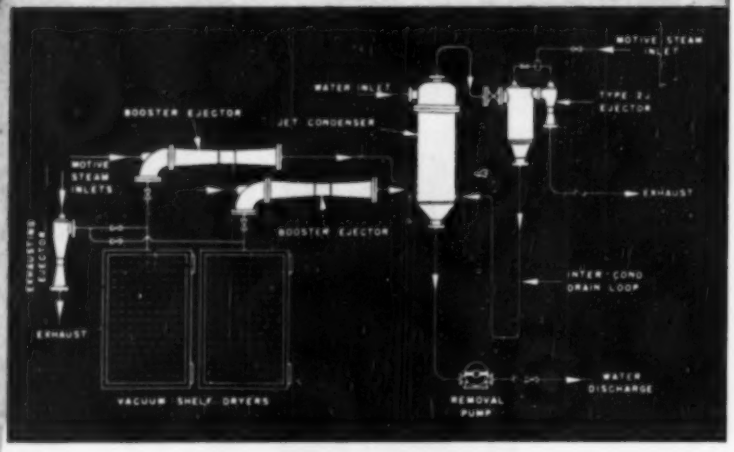
For further information on Walworth Cast Steel Gate Valves, see your local Walworth distributor, or write:

WALWORTH

valves and fittings

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Pointers on Pumps

WHAT HAPPENS WHEN THE SPEED OF A CENTRIFUGAL PUMP IS CHANGED?



The characteristics of a centrifugal pump are revealed by curves showing the relation between developed head and capacity, and between brake horsepower and capacity. These curves are usually based on a constant speed and a definite impeller diameter. When the pump's speed is changed, the resulting changes in its performance curves can be predicted by a few calculations. For every point on the original curves there is a corresponding point on the curves for the new speed — and by plotting a sufficient number of these points, curves can be drawn to show the pump performance at the new speed.

HOW TO PLOT THE PERFORMANCE CURVES FOR A 4" PUMP AT 1600 RPM WHEN THE CHARACTERISTICS AT 1750 RPM ARE KNOWN

GPM = gallons per minute RPM = revolutions per minute
H = head in feet BHP = brake horsepower
At constant impeller diameter:

$$\frac{GPM_2}{GPM_1} = \frac{RPM_2}{RPM_1} = \frac{\sqrt{H_2}}{\sqrt{H_1}} = \frac{\sqrt[3]{BHP_2}}{\sqrt[3]{BHP_1}}$$

Taking 900 gpm and 80 ft. head at 1750 rpm as point number 1, then:

$$GPM_2 = \left(\frac{RPM_2}{RPM_1}\right) GPM_1 = \left(\frac{1600}{1750}\right) 900 = 823 \text{ GPM}$$

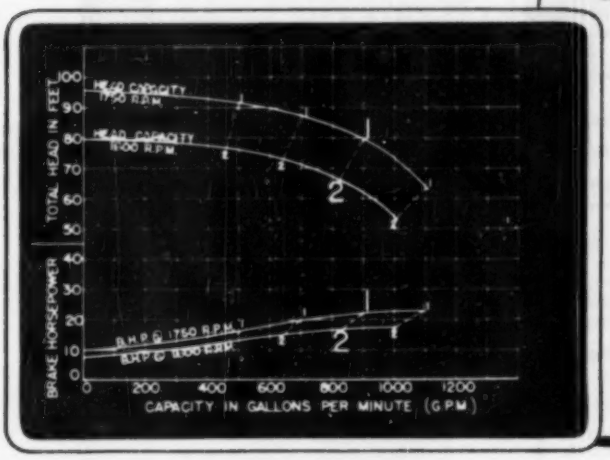
$$H_2 = \left(\frac{RPM_2}{RPM_1}\right)^2 H_1 = \left(\frac{1600}{1750}\right)^2 80 = 66.8 \text{ Feet}$$

$$BHP_2 = \left(\frac{RPM_2}{RPM_1}\right)^3 BHP_1 = \left(\frac{1600}{1750}\right)^3 22 = 16.8 \text{ BHP}$$

By taking other points for number 1, such as 500 gpm at 91 feet, 700 gpm at 87 feet and 1100 gpm at 64 feet, enough corresponding number 2 points are located to draw the expected 1600 rpm performance curve.

NOTE: It is also possible to predict the effect of changing the impeller diameter at a constant speed, by applying the basic formula:

$$\frac{GPM_2}{GPM_1} = \frac{Diameter_2}{Diameter_1} = \frac{\sqrt{H_2}}{\sqrt{H_1}} = \frac{\sqrt[3]{BHP_2}}{\sqrt[3]{BHP_1}}$$

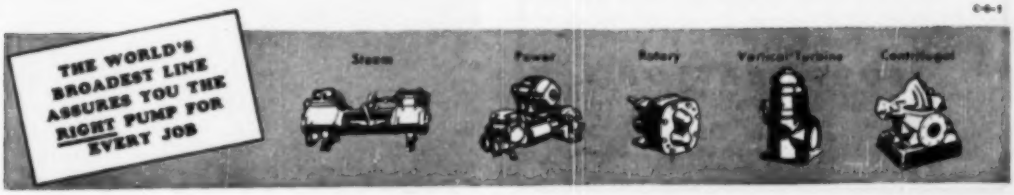




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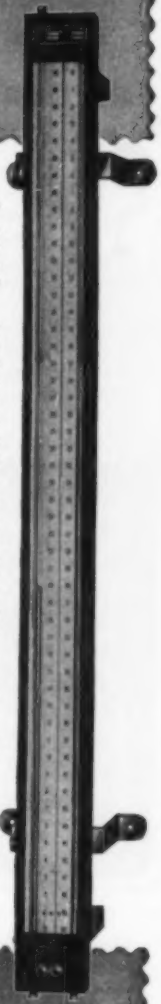
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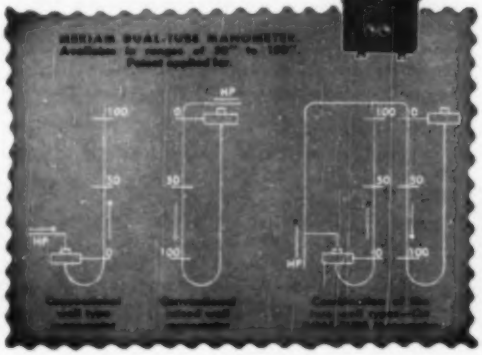
The instrument is ideal as a calibrating standard manometer for checking flow meters, pressure gauges, and other secondary units operating on pressure or vacuum principle. It is direct reading. Since both tubes indicate the same reading, the operator can choose the one most convenient.

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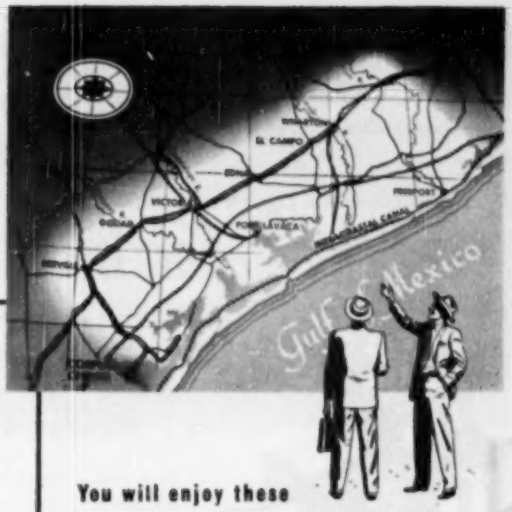
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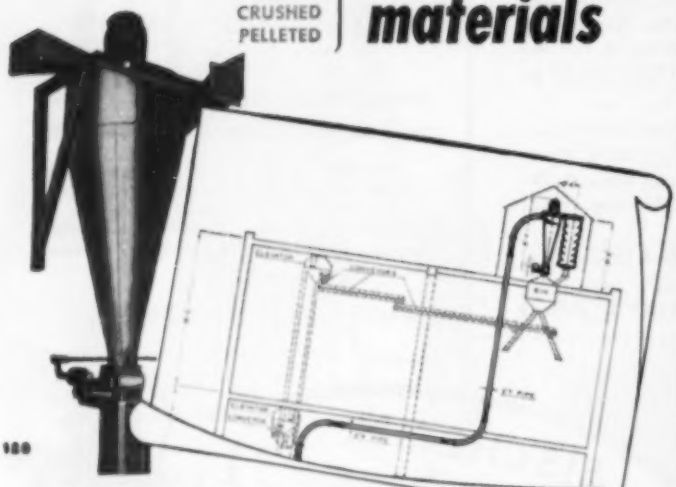
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THE MODERN AIR CONVEYOR SYSTEM

for handling bulk materials

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Fig. 643

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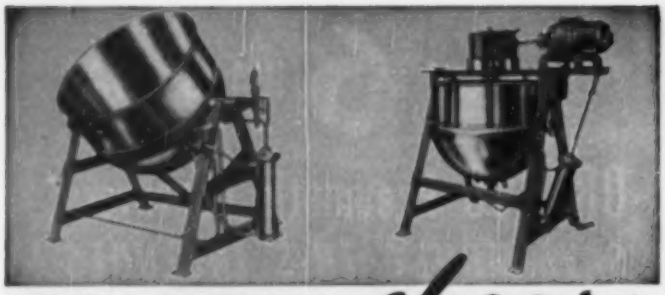


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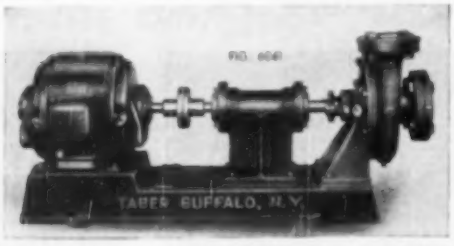
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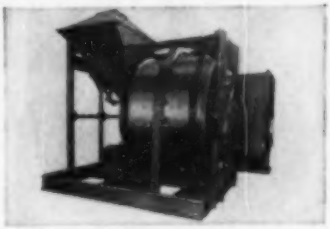
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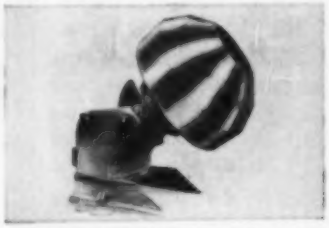
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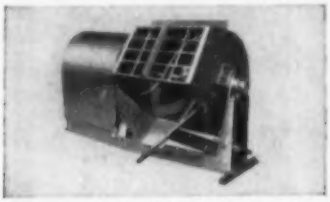
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Album of Achievement

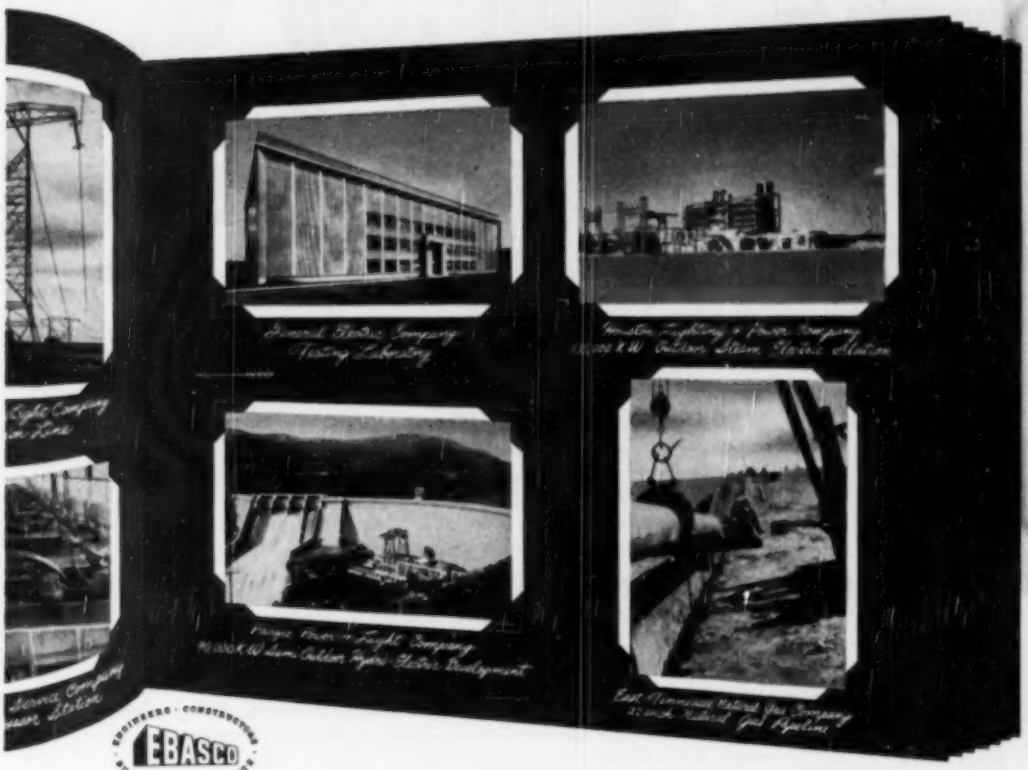
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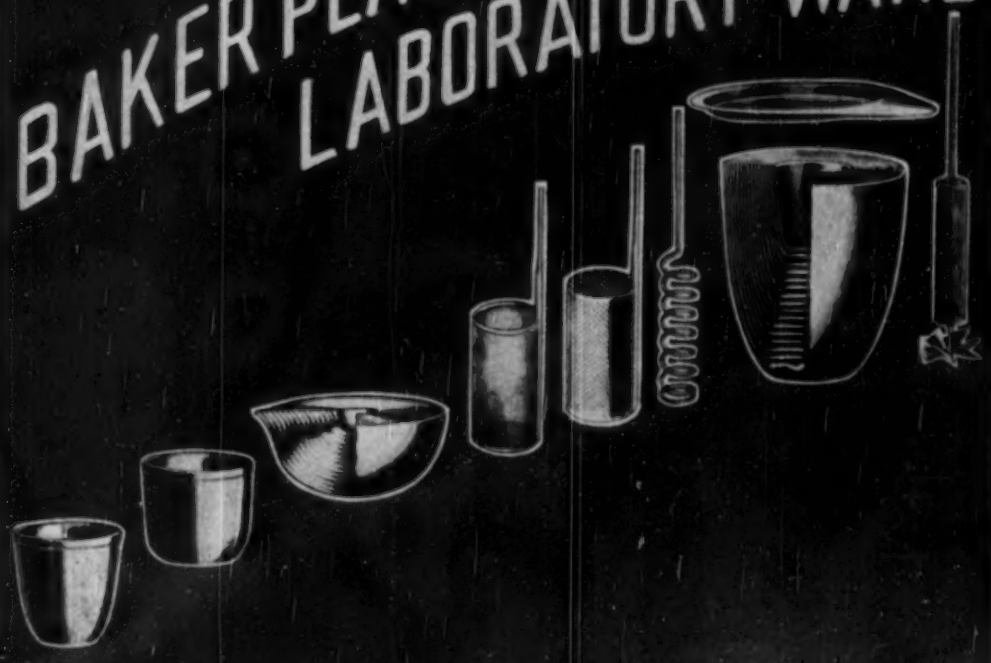
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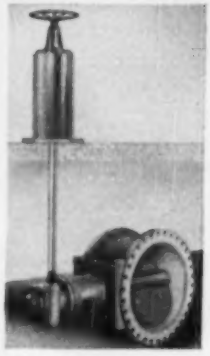
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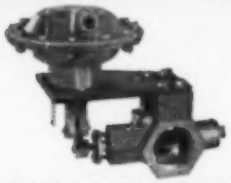
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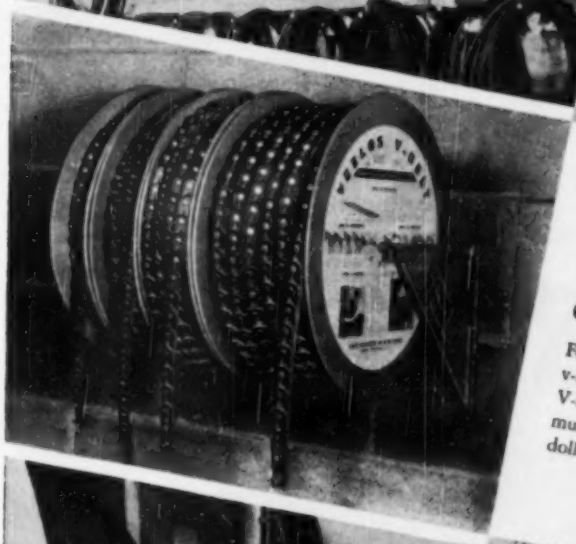


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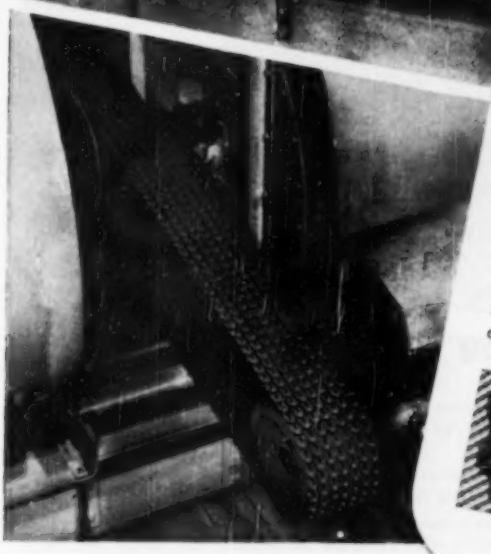
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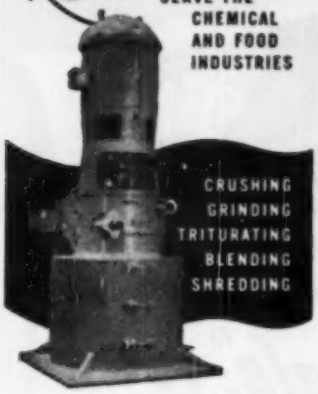
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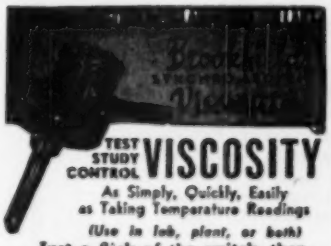


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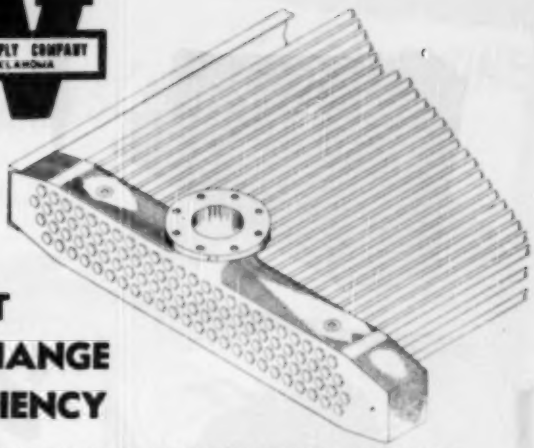
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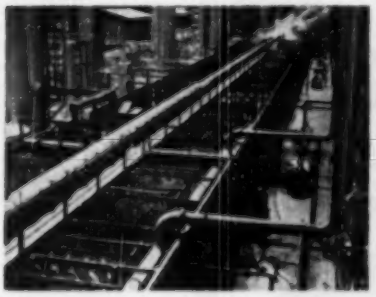
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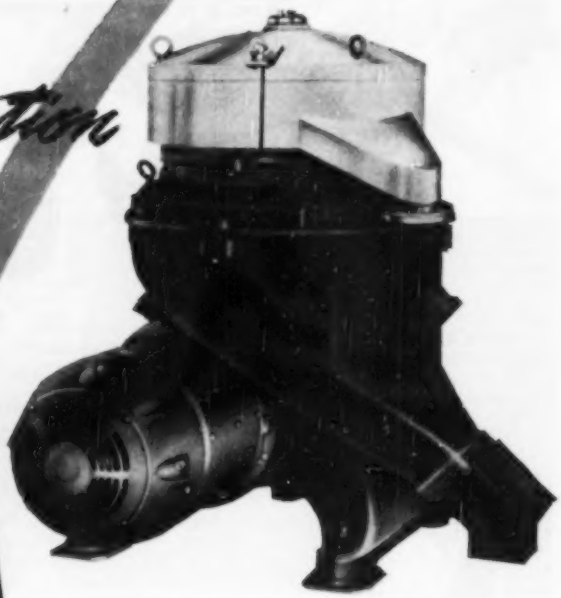
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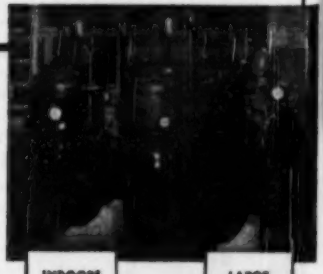


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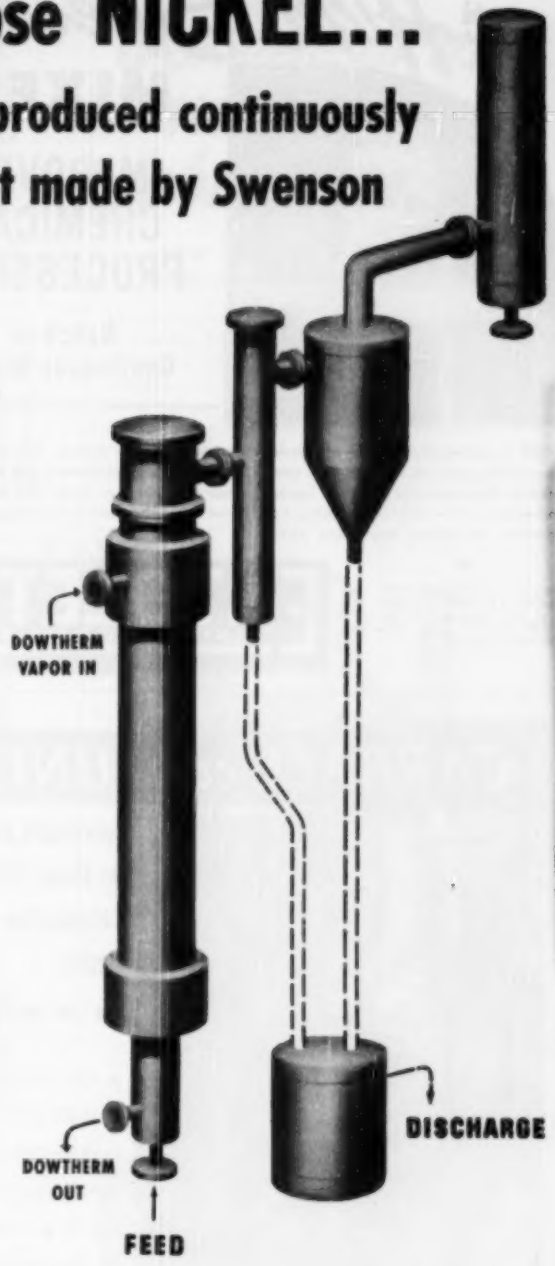
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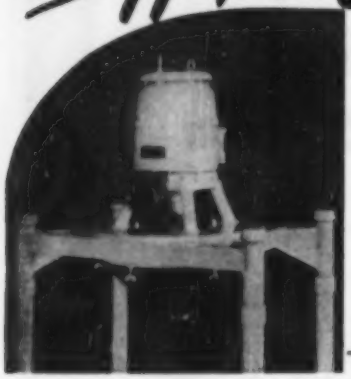


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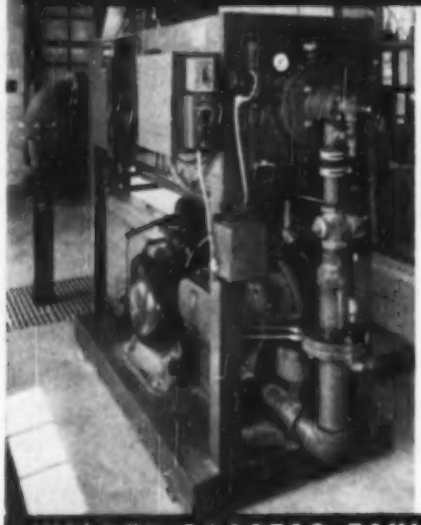
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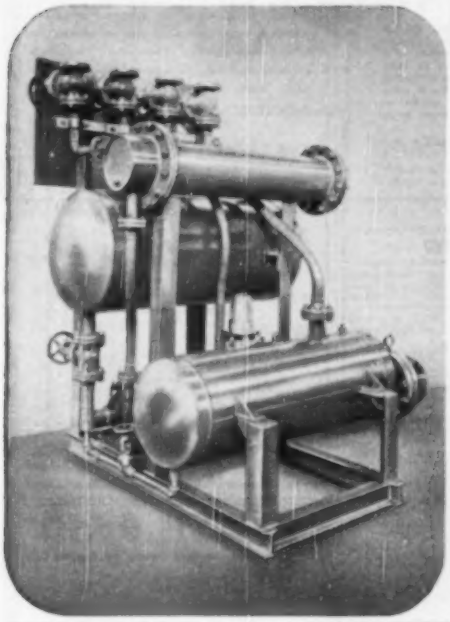
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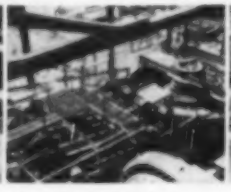
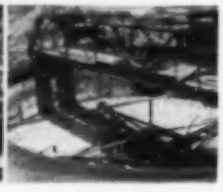
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28"x60" to 32"x120" Double Drum Dryers.
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1—Shriver Filter Press, 36" x 36", closed-delivery, side-feed, 25 Chambers.
1—Shriver Rubber-Lined Filter Press, 36" x 36", 36 Chambers, closed-delivery, 4 eyed, corner feed with 5 ton SECO closing device.
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1—Sperry 36" x 36" Recessed Type Filter, center-feed, open-delivery, 42 Heresite covered Plates.
3—Sperry Filter Press Skeletons, 42" & 56".
1—Sperry Aluminum Filter Press 18" x 18", 9 Chambers.
1—Sperry Cast-Iron 30" Filter Press, Plate & Frame, open-delivery, non-washing type.

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1—Stainless Steel Jacketed Kettle, 200 gals. cap. with M-I Lightnin' Mixer.
1—Stainless Steel Jacketed Kettle 500 gals. cap.
3—Pfaudler Glass-Lined Jacketed Kettles, 300 gals. cap.
14—Pfaudler Glass-Lined Jacketed Kettles, 330 gals. cap.
3—Pfaudler Glass-Lined Jacketed Kettles, 360 gals. cap.
3—Pfaudler Glass-Lined Jacketed Kettles, 400 gals. cap.
1—Stokes Jacketed Kettle, 700 gals. cap.
1—Steel Jacketed Kettle, 2300 gals. cap.
1—Stokes Vacuum Kettle with agitator 14"x12".
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1—Cast-Iron Jacketed Reactor 1,500 gals. cap. with agitator.
1—Cast-Iron Jacketed Reactor 700 gals. cap.
1—Pfaudler Aluminum Jacketed Reactor 250 gals. cap.
6—Pfaudler Glass-Lined Jacketed Reactors 1,700 gals. cap.
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7—Rubber-Lined Storage Tanks 350 & 450 gals. cap.
1—Steel Storage Tank 10,000 gals. cap., 1/" plate.
5—Stainless Steel Storage Tanks 50-180-221 gals. cap.
2—Stainless Steel Storage Tanks 1,000 gals. cap.
1—Stainless Steel Clad Storage Tank 3,100 gals. cap.
3—High Chrome Storage Tanks 3,600 & 6,000 gals. cap.
3—Pfaudler & Glascote, Glass-Lined Horizontal Storage Tanks, 200 gals. cap.
2—Pfaudler Glass-Lined Horizontal Storage Tanks 500 gals. cap.
2—Black & Clawson Double Drum Dryers 28"x5'.
1—Ruggles Cole Rotary Steam Tube Dryer 4'x20'.
1—Ruggles Cole Direct Fired Kiln 7½'x60'.
1—Bartlett & Snow Direct Fired Kiln 9½'x50'.
1—Lancaster Bronze Laboratory Muller.
1—Sanbury Mixer #21 with 50 HP motor.
4—Baker Perkins Jacketed Vacuum Type Double Arm Mixers with Motors & Drives, 100 gals. cap.
1—Cavagnarro Vacuum Type Double Arm Mixers, with Motor & Drive 100 gals. cap., Stainless Steel.
2—Cavagnarro Steel Jacketed Mixers, Chromium Plated, interior double arm, fishtail blades, 100 gals. cap., vacuum type with 40 HP Motors & Drives.
2—J. H. Day Double Arm Jacketed Mixers, 50 gals. cap., sigma blades.
1—Baker Perkins Laboratory Mixer, size #8.
1—Baker Perkins Double Arm Jacketed Mixer, 280 gals. cap., sigma blades.
3—Baker Perkins Double Arm Mixers, 200 gals. cap., sigma blades.
1—Patterson 5,000 gals. cap. Turbo Mixer "Unused."
1—Patterson Nickel-Lined Blender, 192 cu. ft. cap. with 20 HP Motor.
2—J. H. Day Mogul Type Mixers, 2½ and 5 gals. cap.



THE GELB GIRL—NOVEMBER 1950

3—Louisville Rotary Steam Tube Dryers, 6' x 50'.
3—Buffalo Vacuum Shelf Dryers, 6, 12, & 15 Shelves.
1—Buffalo Chrome-Plated Double Drum Dryers, 32" x 90".
3—Buffalo Flakers, 5' x 12'.
2—Buffalo Vacuum Drum Dryers, 24" x 20".
2—Buffalo Vacuum Drum Dryers, 5' 10" x 10'.
3—J. P. Devine Single Door Vacuum Shelf Dryers, 6 Shelves.

5—Simpson #9 Intensive Mixers "Unused".
1—Simpson #1 Mixer.
1—Day Pony Mixer 15 gals. cap.
1—Gemco Copper Conical Blender, 3½ cu. ft.
10—Sweetland Filters, #12, #10, #7, #3, #1 & Laboratory Size.
3—Vallez Filters, #2E, #2B & #3.
10—Alsop Bronze & Brass Filters, Model # PAK-13-4.
2—Alsop Bronze & Brass Filters, Model # SD-12-WR-30.
3—Oliver Rotary Filters, 8'x10', 8'x12' & 3'x4'.
10—Sharples Super Pressurite Centrifuges #6.
2—Sharples Super Pressurite Centrifuges, Stainless Steel Bowl, Model #16T.
1—Podbielniak Stainless Steel Centrifugal Extractor Model #9880.
1—Bayle #1 Perfected Extruder, with heating unit.
1—Badger Stainless Steel Still with 12" Bubble Cap Column, 9 Plates, 25 sq. ft. Stainless Steel Condenser, Still Pot & Receiver.
1—American Locomotive Stainless Steel Heat Exchanger, Model Twin Double Pipe, Size 3½x27'x24.
1—Struthers-Wells Stainless Steel Condenser, 370 sq. ft.
1—Allis Chalmers Tube Mill 5'9"x10', Silex-Lined.
3—Hardinge Conical Ball Mills 6'x30", 5'x22", 6'x22".
1—Abbe Engineering Silex-Lined Pebble Mill, 6'x12'.
1—Abbe Engineering Buhrstone-Lined Ball Mill, 5'x6'.
1—Ball Mill, Stone-Lined 7'x9'.
1—Kent Laboratory 3-Roll Paint Mill, 4"x8".
1—Eppenbach Stainless Steel, Colloid Mill, Model #QV7.
1—KEMCO 2-Roll Laboratory Mill 6"x12".
1—Blaw-Knox Jacketed Autoclave 3'x4'2" with agitator.
1—Blaw-Knox 3 gal. Stainless Steel Laboratory Autoclave with anchor type agitator 1,000 psi.
1—High Pressure Steel Autoclave, 900 psi, 3'x6' with agitator and motor reducer.
1—Cumberland Granulator with 15 HP Motor.
1—Mikro Pulverizer #2TH with 15 HP Motor.
1—Mikro Bantam size Bronze Pulverizer.
1—Mikro Stainless Steel Atomizer, #6, with 30 HP Motor.
1—J. H. Day #71 Ro-Ball Jacketed Stainless Steel Gyrating Screen Cooler.
2—Orville Simpson #41, Rotex Screens.
2—Wilson Pulsafeeders, Model # DELDO.

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2 Double Drum Dryers 22" x 38"

1 Vacuum Pan Dryer 10' dia. x 3' deep

1 Tray Dryer, Atm., 1050 sq. ft.

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1 Rotary Vacuum Filter, 6' x 3', steel

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25 Glass Lined Steel Tanks, 7500 gal. & 8250 gal.

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2 Copper Water Stills, 50 GPH

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1	30	A. C.	405	1760
5	20	A. C.	326	3550
1	20	A. C.	404	1160
2	20	A. C.	324	1730
4	15	A. C.	365	1160
9	5	A. C.	284	1160
3	3	Cr. Wh.	224	3460
2	3	A. C.	224	3500
3	1½	A. C.	204	3500
1	1½	A. C.	204	1730
2	1½	A. C.	224	1160
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1 W & P Double-Armed Lab. Mixer.
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1—Szegvari attriter 60 gal jktd
1—500 gal Nickel jktd vac still with 14" x 8' column, with condenser
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10—Philadelphia 10 HP vertical agitated drives, 420 RPM
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1—30,000#, 425#
1—15,000#, 150#
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2—600 HP, 200#
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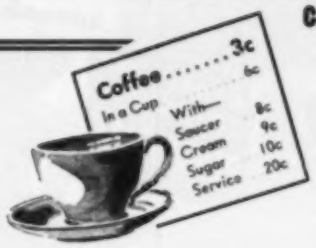
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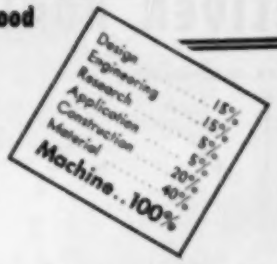
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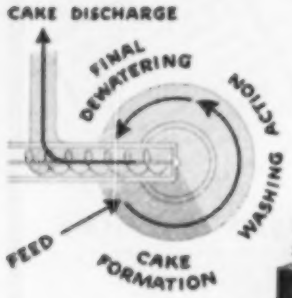
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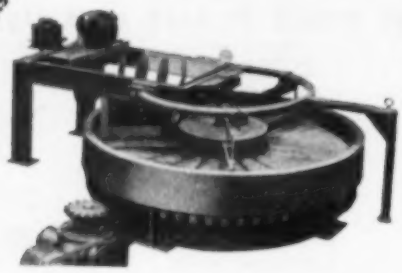
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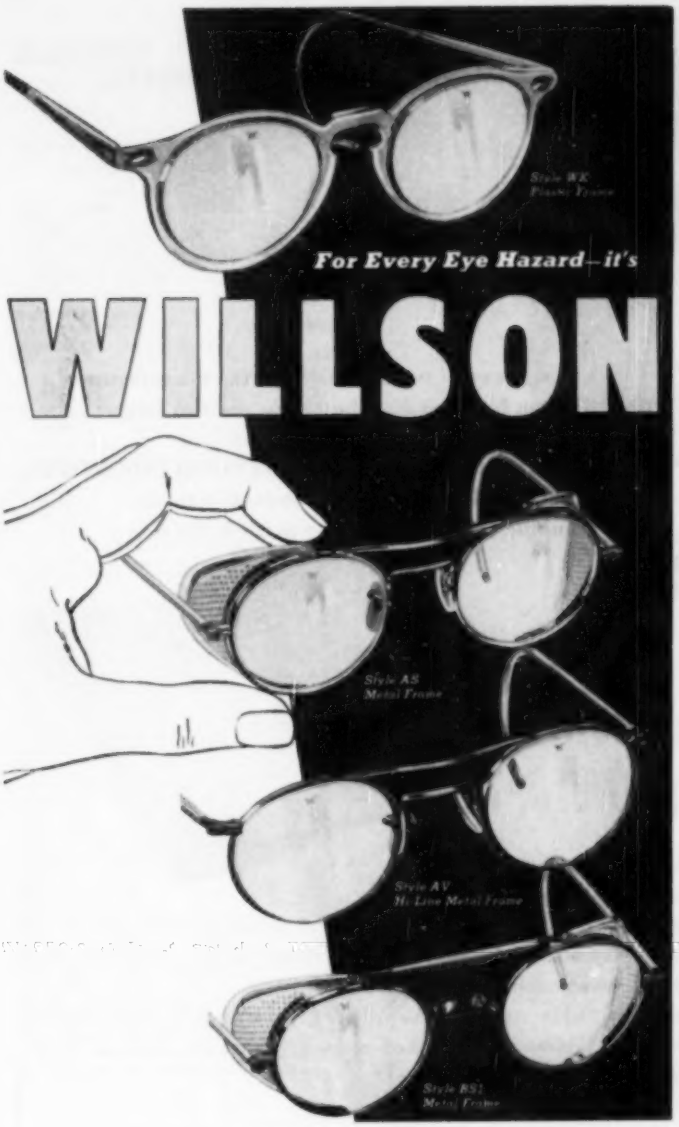
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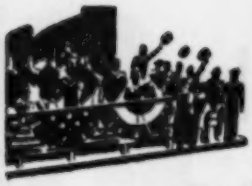


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Chemical Engineering Reader Service

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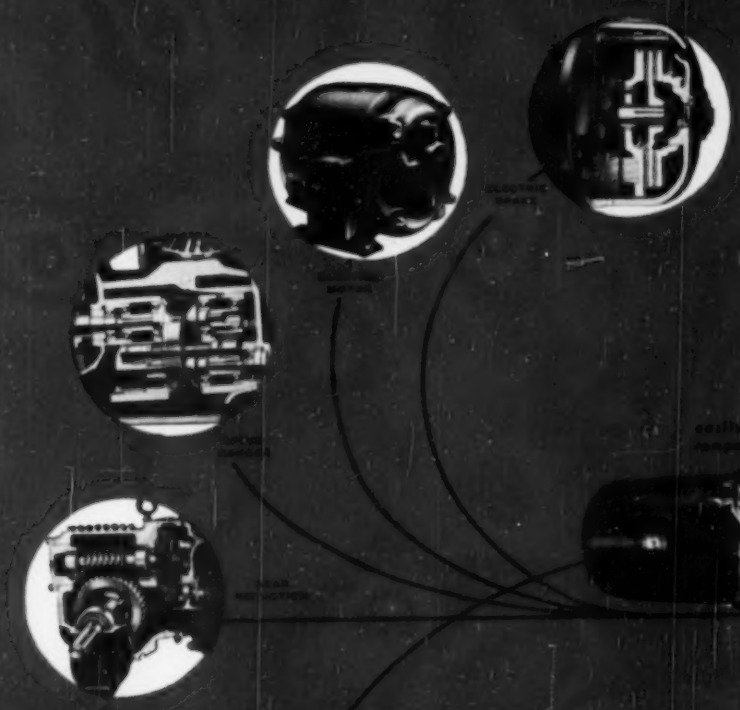
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